Beneficial Use Reconnaissance Program Field Manual for Streams

Department of Environmental Quality

Beneficial Use Reconnaissance Program Technical Advisory Committee

Revised: April 2004

List of Tables

List of Figures

Abstract

The purpose of the Beneficial Use Reconnaissance Program (BURP) is to help Idaho meet the requirements of the federal Clean Water Act by assisting with determinations of the existing uses and beneficial use support status of Idaho's water bodies. BURP started in 1993 as a pilot project and evolved into an ongoing program.

The BURP program conducts monitoring activities at selected sites, emphasizing sampling and analysis to support assessments of biological assemblages and physical habitat structure of streams. These assessments support characterization of individual stream integrity and the total quality of Idaho's waters. The Department of Environmental Quality's (DEQ's) past monitoring and assessment practices and the U.S. Environmental Protection Agency's rapid bioassessment protocols provided the foundation for BURP monitoring protocols.

This field manual provides information needed for consistency in monitoring among DEQ crews along with other entities interested in following these methods. This manual is an important part of the quality assurance/quality control of BURP stream monitoring data.

This field manual includes a process for selecting representative sampling sites and a suite of variables to sample. Each variable is defined and the rationale for using it is given, along with a description of the field methods used to measure or collect it. Selected literature is cited and literature for further reading is referenced at the end of the manual. The main variables include discharge, width/depth, shade, bank cover and stability, substrate, habitat types, pool complexity, large organic debris, stream channel classification, habitat assessment, temperature, conductivity, macroinvertebrate assemblages, periphyton assemblages, fish assemblages, bacteria (*E. coli*), and amphibians. The manual describes how to make a record for each reach that includes a standardized stream name, exact reach location (latitude and longitude), and photographs. Later in the assessment process, the data collected during BURP monitoring will be compared to data from reference sites.

Safety of BURP monitoring activities is very important and is stressed in this manual. A decontamination section also emphasizes the importance of cleaning field gear to help prevent the transfer of aquatic organisms, diseases, and plant life.

Acronyms, Abbreviations, and Symbols

mmhos	micromhos
mS/cm	microsiemens per centimeter
AU	assessment unit
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
BURP	Beneficial Use Reconnaissance Program
CALM	Consolidated Assessment and Listing Methodology
cfs	cubic feet per second
CPR	cardiopulmonary resuscitation
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
EDMS	Environmental Data Management System
EF	electrofishing
EPA	U.S. Environmental Protection Agency
ETOH	ethyl alcohol
GNIS	Geographic Names Information System
GIS	geographic information system
GPS	global positioning system
HUC	hydrologic unit code
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
LOD	large organic debris
LWD	large woody debris
m	Meter
mg/L	milligrams per liter
ml	milliliter
mm	millimeter
MSDS	material safety data sheets
NRCS	National Resource Conservation Service
PEL	permissible exposure limit
ppm	parts per million
QA	quality assurance
QC	quality control
SHI	stream habitat index
SMI	stream macroinvertebrate index
STORET	Storage/Retrieval Data System
TWA	time weighted average
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WBAG	Water Body Assessment Guidance

WBID	water body identification system; individual water body identification
WD	wetted depth
W/D	width:depth ratio

Introduction

Development of the Beneficial Use Reconnaissance Program

The Beneficial Use Reconnaissance Program (BURP) has evolved from a pilot project into an ongoing program. In 1993, a pilot project aimed at integrating biological and chemical monitoring with physical habitat structure assessment to characterize the integrity of a stream and the quality of its water (McIntyre 1993a) was initiated by the Division of Environmental Quality (now the Department of Environmental Quality [DEQ]). This pilot project was also developed in order to meet the Clean Water Act requirements of monitoring and assessing biology and developing biocriteria. This pilot relied heavily on protocols for monitoring physical habitat and macroinvertebrates developed by Idaho State University and DEQ in the early 1990s. It closely followed the rapid bioassessment protocols for use in streams and rivers developed by the U.S. Environmental Protection Agency (Plafkin et al. 1989, Barbour et al. 1999). In the pilot, the project attempted to use the best science and understanding available to characterize water quality based on biological communities and their attributes.

Current BURP Organization, Process, and Results

The successful 1993 pilot was expanded statewide in 1994 (McIntyre 1994; Steed and Clark 1995) and is now an ongoing program. The BURP organization consists of a central contact person, regional coordinators, and technical support staff. The program contact person in the state office provides overall planning, budget control, and oversight. The program is implemented by the regional BURP Coordinators, who prepare for and direct each year's field work. This includes developing methods, hiring crew members, conducting centralized training, supplementing centralized training as needed with regional information, and directing field work. Also, throughout the season the BURP Coordinators ensure data (chiefly field forms) and samples are properly submitted for analysis. The regional BURP Coordinators plan and supervise their field work each year in accordance with the annual work plan (see Clark 2003 for an example). Technical Services staff members in the DEQ state office prepare the annual BURP work plan, manage the BURP database, ensure quality assurance requirements are met, and provide technical expertise as requested. The activities in the BURP work cycle, along with the way the results of BURP monitoring are used, are shown in Figure 1.

Purpose and Scope of This Manual

The purpose of this field manual is to provide information needed for statewide consistency in BURP stream monitoring and data collection activities. This manual describes how BURP collects data, laying out the assumptions, methods, and equipment required. Further information regarding annual objectives, pilot studies, and anticipated monitoring locations are provided in the annual BURP work plan.

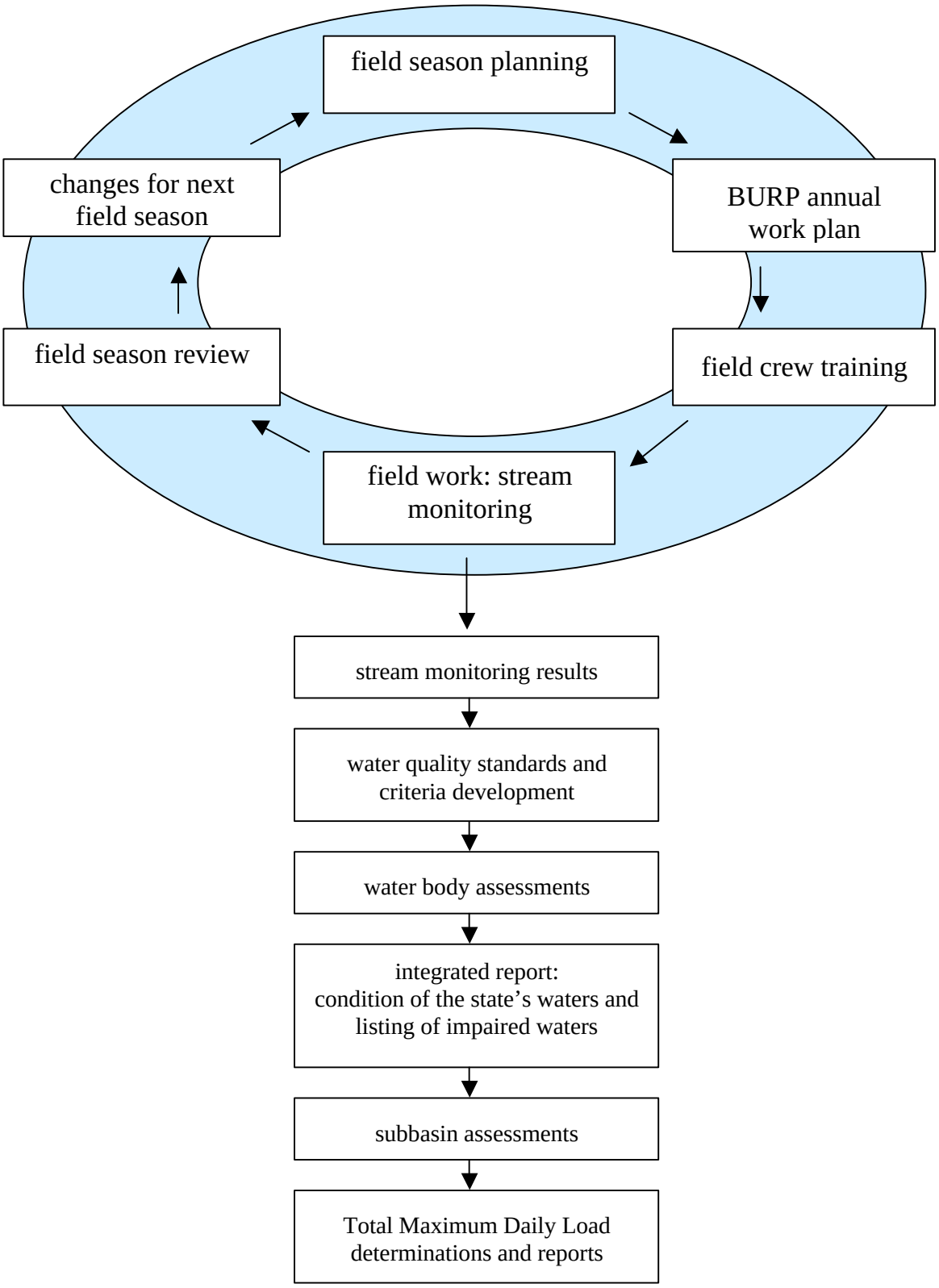


Figure 1. Annual work cycle and use of monitoring results.

This manual does not describe the analysis and interpretation of the data collected. Interpretation of BURP data and any other relevant water quality information is described in DEQ's *Water Body Assessment Guidance* (WBAG II) document (Grafe et al. 2002a), which outlines the process DEQ uses to determine the beneficial use support status of designated and existing beneficial uses.

The manual provides BURP crew members with specific protocols used in BURP monitoring surveys. Information is included for each monitoring variable, along with other information about BURP field work. In addition, a rationale for including each variable and for the method used to monitor that variable are presented, so others can follow the same protocols if they choose.

Organization of This Manual

This manual is divided into six main sections. The first four correspond with the four phases of BURP field activities depicted in Figure 2.

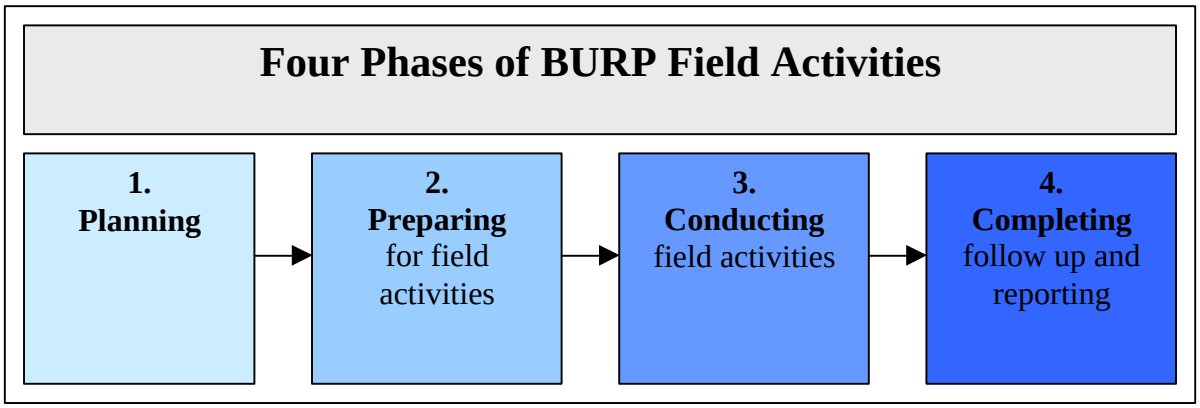


Figure 2. Four phases of BURP field activities.

Section 1 discusses planning and section 2 covers preparing for field activities. Section 3, Conducting BURP Field Activities, includes the detailed protocol methods used by BURP field crews, and is by far the most detailed. Its organization follows that of the field forms that are filled out as monitoring activities are conducted at a site, so that each variable recorded during a BURP survey is discussed in this manual in the same order and under the same name as it appears on the field forms. Within section 3, each page of the field forms has a subsection and each variable has a further subsection within that.
Section 4 contains a brief description of activities that must be completed during a BURP survey. Section 5 discusses quality assurance and quality control (QA/QC), while section 6 discusses safety. The last sections are literature references, a glossary, an index of monitoring variables, and appendices.

Overview of BURP Field Activities

These four phases (planning, preparing, conducting, and completing) make up the annual BURP cycle. The typical time of year for conducting each phase is shown in Figure 3.

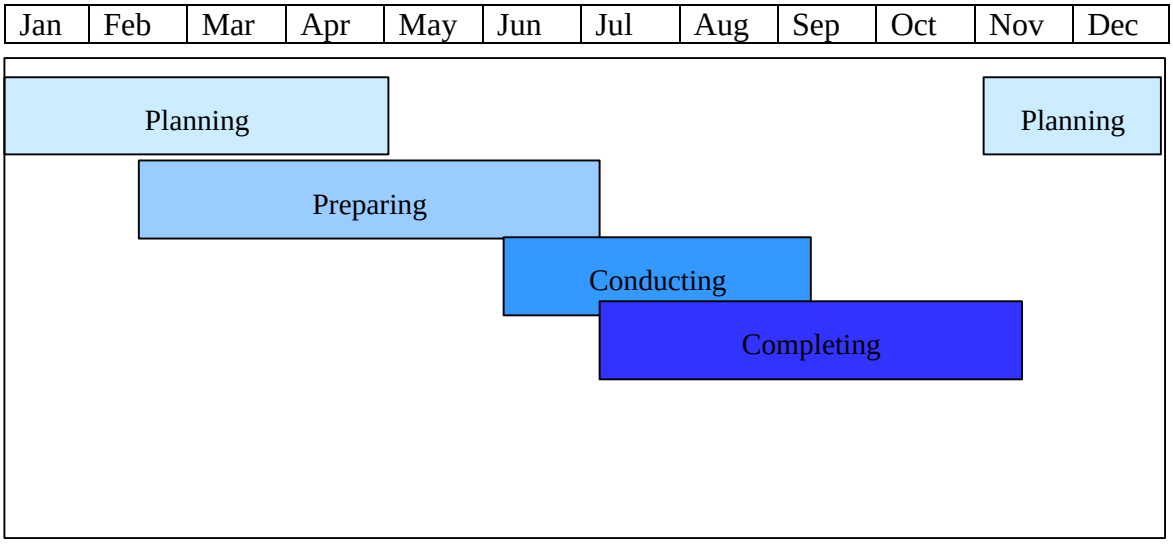


Figure 3. Typical timing of the four phases of BURP field work.

1 Planning BURP Field Activities for Streams

The planning phase is broken down into four parts: reviewing related data, coordinating aquatic monitoring, determining size classification of targeted water bodies, and pre-selecting BURP monitoring sites (final site selections will be made in the field). These four parts are shown in the Planning box in Figure 4.

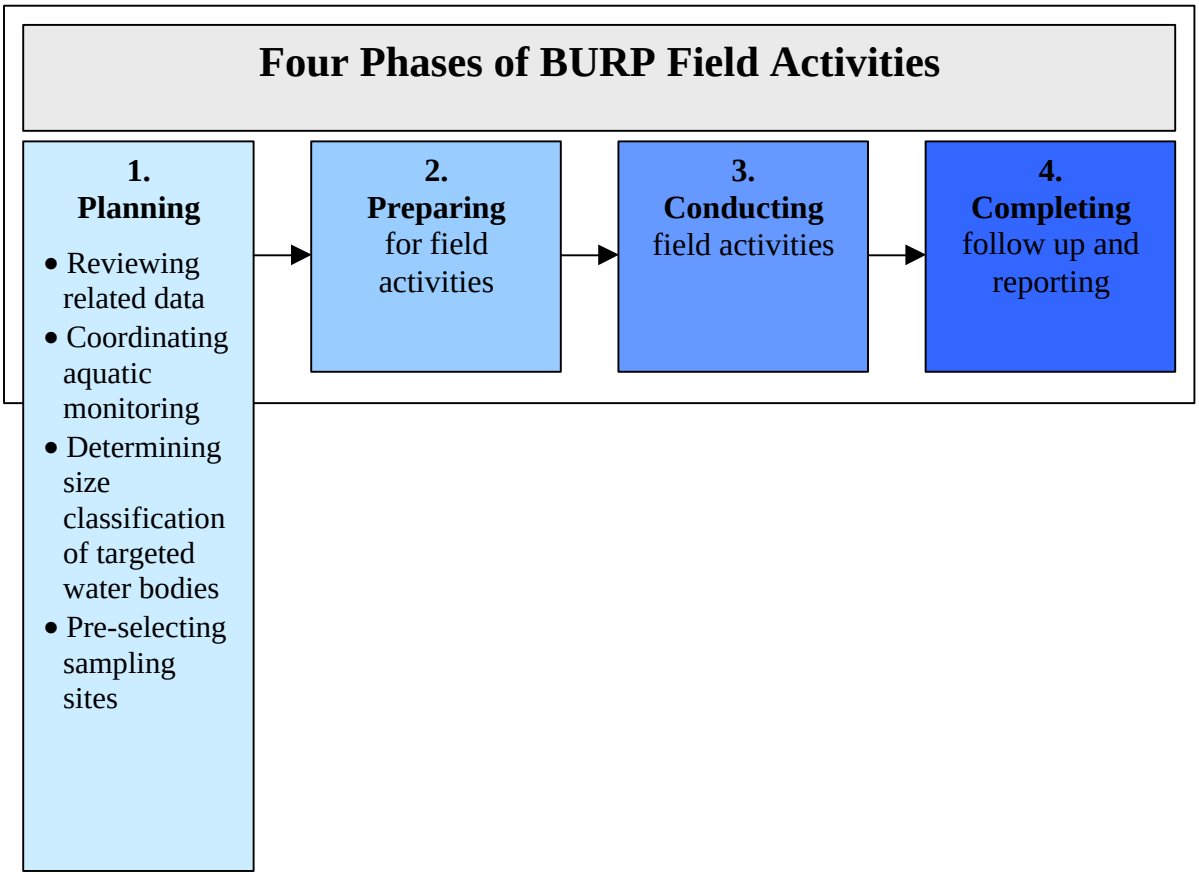


Figure 4. Parts of the planning phase.

1.1 Reviewing Related Data

It is important to review stream and geographic data and other information from outside DEQ when preparing to monitor water bodies. This is a cost-effective step that should be performed for each monitoring reach. To identify potential data sources, the regional BURP Coordinator should try to obtain data and information about the targeted water bodies from resources including:

State Agencies

- Idaho Department of Fish and Game (IDFG)
- Idaho District Health Departments

- Idaho Department of Water Resources (IDWR)
- Idaho Department of Environmental Quality (DEQ) (internal sources)

Federal Agencies

- Bureau of Land Management (BLM)
- Bureau of Reclamation (BOR)
- Natural Resource Conservation Service (NRCS)
- U. S. Bureau of Mines
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Forest Service (USFS)
- U.S. Geological Survey (USGS)
- U.S. Environmental Protection Agency (EPA)

Tribal Nations

- Native American tribal nations with an interest in or information about the water bodies to be studied

Academic Institutions

- Universities
- Professional academies

Information Repositories

- Environmental Data Management System (EDMS)—an IDWR database
- STORET—an EPA database

Miscellaneous Resources

- GIS coverages from DEQ and other agencies
- Hydropower companies
- Private companies in timber, mining, and other related industries
- Internet searches
- Other appropriate resources

Information obtained from these sources should be included with the total information used to select sampling sites and also kept with the site or water body file so it may be incorporated in the assessment process as recommended in Grafe et al. (2002a).

1.2 Coordinating Aquatic Monitoring Statewide

It is strongly recommended that each DEQ regional office either facilitate or participate in an annual monitoring coordination meeting. This is consistent with the *Consolidated Assessment and Listing Methodology* (CALM) (EPA 2002), which identifies the need to coordinate or inventory monitoring activities.

To be successful, this effort requires input and participation from all state, federal, tribal, and private entities engaged in aquatic monitoring. An effective coordination meeting will reduce duplication of effort, improve program efficiency, increase sharing of scientific and biological data and sources, and facilitate networking among all agencies and personnel involved in aquatic monitoring. Appendix A contains a sample invitation letter for an aquatic monitoring coordination meeting.

1.3 Determining Whether to Use the BURP Stream Protocol

1.3.1 Importance of Determining Water Body Size

DEQ found that only two size categories were necessary to represent small to large water body characteristics for bioassessment purposes.
This size distinction is critical in BURP methodology because DEQ uses different monitoring protocols and bioassessment tools for assessing the aquatic life support use of streams and rivers. The methods in this manual are for streams only, so it must be determined whether the water bodies where BURP monitoring is planned are classified as streams by DEQ.

1.3.2 Use of the Terms "Streams" and "Rivers"

The *Water Body Assessment Guidance* (Grafe et al. 2002a) uses water body size criteria to distinguish between two classes of flowing water: streams and rivers. Previously, the smaller stream classification was referred to as "wadeable streams" or "small streams." However, the distinctions between "wadeable" and "non-wadeable" are not always clear. Similarly, the meaning of "small" was not always uniformly defined. DEQ decided to simply call the smaller size classification "streams" and the larger classification "rivers." It should be noted that these classifications are specifically for DEQ use and the terms may not defined the same way in standard dictionaries.

1.3.3 Water Body Size Determinations

Through literature review and data analysis, DEQ found that no one criterion entirely distinguishes among water body sizes in Idaho. Consequently, DEQ uses three criteria to determine water body size: stream order, average wetted width at base flow, and average depth at base flow. The method for making this determination is given below. Supporting analysis for this method is detailed in "Water Body Size Criteria" (Grafe 2002b).

1.3.4 Method for Classifying a Stream or a River

DEQ rates a water body against each criterion, as shown in Table 1, and then averages the rating or score (total rating points divided by three criteria).

Table 1. Points for Rating Water Body Size Based on Three Criteria

Criteria			Corresponding Size Category and Rating Points
Stream Order	Avg. Wetted Width at Base Flow (m)	Avg. Depth at Base Flow (m)	
≥ 5	≥ 15	≥ 0.4	Large/River: 3
< 5	< 15	< 0.4	Small/Stream: 1

If a water body's average score for these three criteria is greater than or equal to 1.7, DEQ designates it a river; if its average score is less than 1.7, it is classified a stream (Table 2).

Table 2. Water Body Size Classifications Based on Average Rating Scores

Average Rating Points Score	Water Body Class
≥ 1.7	River
< 1.7	Stream

If a water body does not score the same on all three criteria (i.e., it scores two 1s and a 3, or two 3s and a 1), evaluate it further using additional measures of stream size. The ultimate goal of classifying water body size is to ensure that the proper monitoring and assessment protocols are used. If a water body originally considered to be a stream has physical and biological characteristics indicative of a river, the river protocols should be used instead of the stream protocols in this manual.

1.4 Site Selection Process

The site selection process entails both office and field steps to ensure efficiency and representativeness. Although only the pre-selection steps are part of the planning phase, the entire site selection process is outlined here. The pre-selection steps are presented in detail here; the final selection steps are presented in sections 2 and 3.
Selecting monitoring sites that are representative of entire water bodies is critical to how the data may be interpreted and assessed. Specifically, the objectives of the site selection process are to:

- determine how many sites are needed to characterize the beneficial use status of the stream
- help ensure that sampling sites do represent the streams they are intended to represent
- verify in the field that sites initially selected in the office can be used.

1.4.1 Ensuring Representativeness

BURP currently attempts to representatively monitor every stream in Idaho. From 1993 through 2001, DEQ surveyed more than 4,000 sites. These sites represent about 60% of the 2,500 water body identification (WBID) units and 4,700 assessment units (AUs). A WBID usually represents a small watershed and is used in Idaho's water quality standards to geo-locate waters in the state. The scale of a WBID is generally comparable to a 6th-field (12-digit hydrologic unit code [HUC]) watershed although some may be larger or smaller. The AU is a mechanism for grouping waters within a WBID into a meaningful unit for assessment purposes. Presently, most AUs are grouped based on stream order and land use; however, DEQ staff members have the option to further delineate AUs based on additional information. Therefore, the number of WBIDs in Idaho is presently a fixed total, whereas the total number of AUs will continue to change based on current and future assessment decisions. Figure 5 illustrates the scale differences among HUCs, WBIDs, and AUs.

DEQ uses stream order to define AUs within WBIDs to characterize comparable water body segments and ensure representative monitoring sites. In essence, AUs allow DEQ to compare streams and interpret site data. Presently, DEQ attempts to representatively monitor all AUs. To effectively monitor all the streams in Idaho, any one BURP reach should not represent more than AU. (It should be noted that first and second stream orders are combined when defining AUs.) In other words, if a WBID has three AUs, then at least one BURP reach per AU must be established to assess beneficial use support status for the entire stream. Regional BURP Coordinators sometimes consider Rosgen stream type(s) as well when choosing reaches for BURP monitoring. Each reach's length must equal 30 times the general bankfull width, or a minimum of 100 meters. Figure 6 illustrates placement of a BURP reach in an AU. Figure 11 (page 20) provides more details regarding the BURP reach layout.

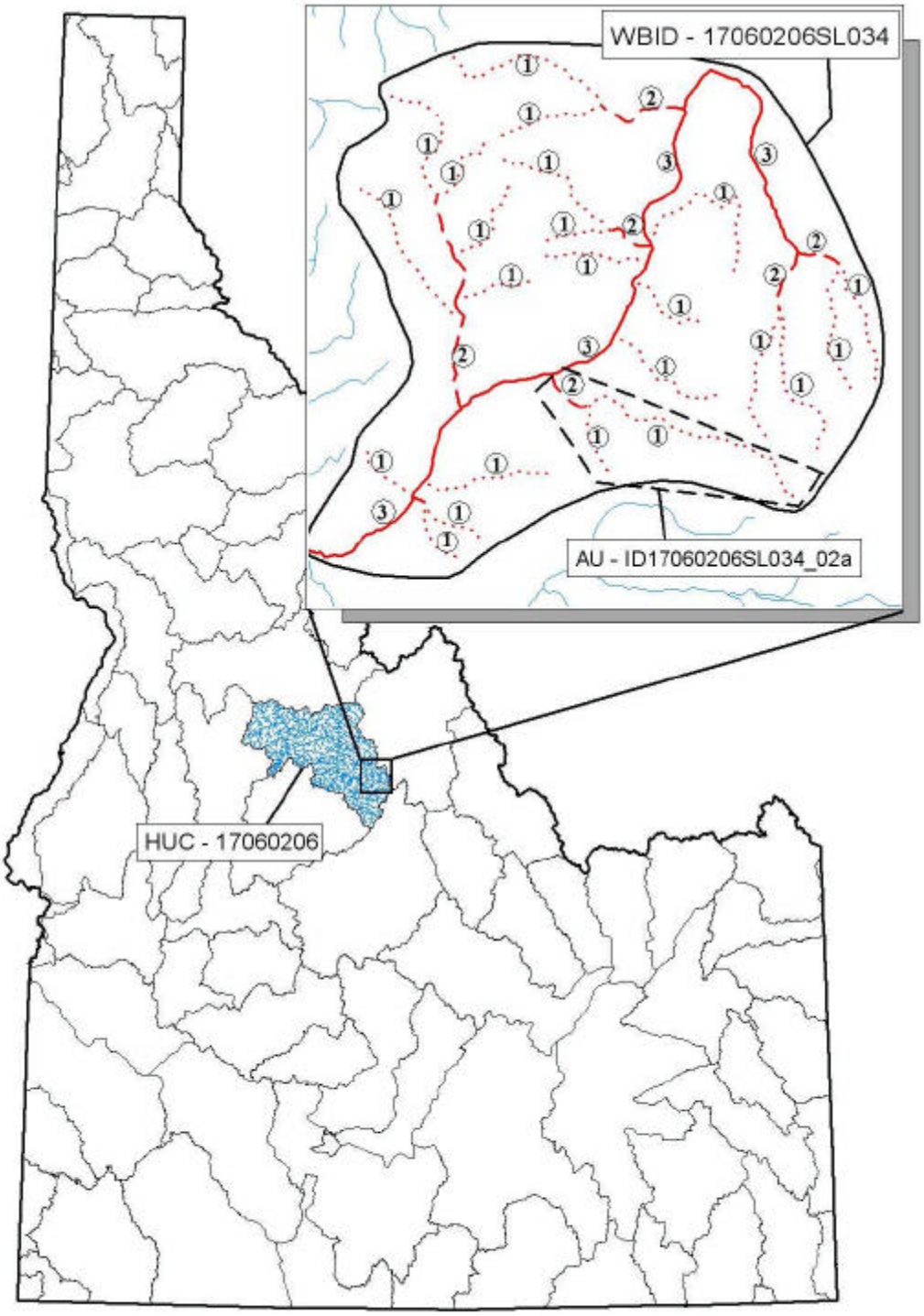


Figure 5. Scale differences among HUCs, WBIDs, and AUs

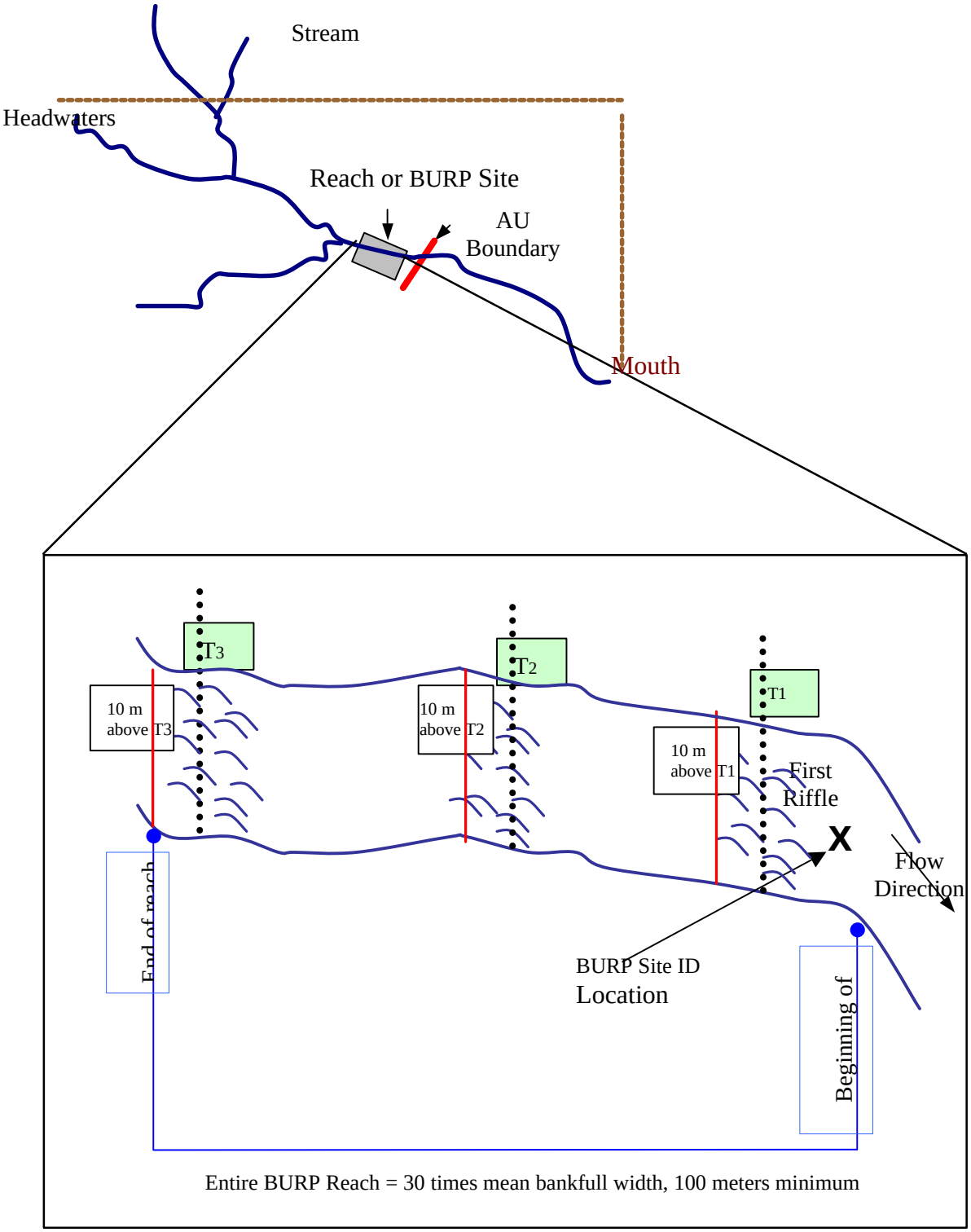


Figure 6. Placement of a BURP reach in an AU.

1.4.2 Steps in the Site Pre-Selection Process

To ensure assessments can be applied to longer stream reaches or entire streams, the BURP monitoring sites must be representative. DEQ uses standard pre-selection steps to identify potentially representative sites. These pre-selection steps are done in the office before the field season starts. The BURP Coordinator starts by consulting with other resource agency representatives, reviewing existing stream data, investigating aerial photos, and gathering other information.
Next, the BURP Coordinator selects several reaches that appear to represent the AU for a particular water body. The following in-office procedures summarize this pre-selection process and its documentation.

- Photocopy the portion of a 1:24,000 topographical map(s) that includes the water body to be monitored.

- Write the site ID and map scale on the map and include it with the site file. (BURP sites will be marked on the map later, when they are confirmed.) Figure 7 is a sample of such a map.

- Determine AUs for the entire length of the water body. Remember that first and second order streams are usually combined into one AU within a WBID (Grafe et al. 2002a). In these cases, use the second order portion to represent the water body. Select the first stream order only if it is defined as a separate AU by DEQ staff.

- Identify major land use changes (based on forest practices, grazing, agriculture, development or other uses) and mark them on the map. Note that these may be determined or modified when the field crew visits the site. See Figure 7 for an example.

1.4.3 Random Site Verification Process

The randomly generated site lists are generated in two parts, a target list and an alternate list. Every effort to sample target sites should be made, however some sites are considered non-sampleable. See section 1.4.3.1 and 1.4.3.2 for categories of non-sampleable sites. If a target site is not sampled, this must be documented by creation of a BURP Site Identification number and listing the reason why the site was not sampled according to the following protocols. Then the next sequentially numbered site from the alternate site list must be monitored so that the total number of sites laid out in the Ambient Monitoring Plan is monitored.

1.4.3.1 Safety

Although every effort should be made to access the exact x-site, there are considerations that make this impractical. Safety of the crew is the primary concern and should the crew feel that either accessing or working at a site is unsafe, it should be dropped and the next alternate-list site picked up. Cliffs, high flows and unsafe trails are examples of these safety issues. If a site cannot be reached at the present time due to barriers that may not be present at some future date (e.g., forest fire, high water, temporary road closure, unsafe weather conditions) the site should be recorded as "Not Visited –Temporarily Inaccessible." Whether to access a remote site is left to the discretion of the regional coordinator. As a guideline, for those sites located in remote,

roadless, or wilderness areas a minimum of a two-hour hike should be attempted to access the site. Additional resources may used to allow for packing into a site or for air transport at the discretion of the regional office.

1.4.3.2 Non-Sampleable Categories

Following are reasons for a site to be considered non-sampleable, along with directions on how to record this on the field forms.

1.4.3.2.1 Dry Channel

A visible stream channel is present but there is no flowing stream present within a reach centered on the x-site that is 30 times as long as the bank full width. If this is determined at the time of sampling visit, record "Visited-Dry"on the field form ; if the site was determined to be dry (or otherwise non-perennial) from another source and/or field verified before the actual sampling visit, record as "Not Visited-Dry."

1.4.3.2.2 Wetland (no definable stream channel)

There is standing water present, but no definable stream channel. In cases of wetlands surrounding a stream channel, define the site as Target but restrict sampling to within the stream channel. Record x-site as "Visited-Wetland" if this determination is made at the time of the site visit or record "Not Visited-Wetland" if this determination is made from another source and/or field verified before the actual sampling event.

1.4.3.2.3 Map Error

Based on ground truthing, no evidence exists that a water body or stream channel was ever present at the coordinates provided or within a 150-meter diameter of the x-site. Record site as "Visited-Map Error." If a water body is present within a 150-meter diameter of the x-site, establish an x-site at an equivalent position on the stream and continue sampling making note of the change in latitude and longitude of the x-site. If a dry stream channel exists within a 150-meter diameter of the x-site, establish an x-site at an equivalent position on the stream, determine the upstream and downstream direction of the stream, determine the GPS latitude/longitude, and coordinate the readings on an ArcView map for positional placement.

1.4.3.2.4 Impounded Stream

If the stream is submerged under a lake or pond due to man-made or natural (e.g., beaver dam) impoundment, record the stream as "Visited-Altered" and do not sample.

1.4.3.2.5 Access Permission Denied

The site must be recorded as "Not Visited-Access Denied."

1.4.3.2.6 Permanently Inaccessible

If the site is unlikely to be sampled by anyone due to physical barriers that prevent access to the site (e.g., cliffs), record the site as "Not Visited-Inaccessible."

1.4.3.2.6.1 Other

If the site is not sampleable for reasons other than those above, reasons may include:

1.4.3.2.6.2 Threatened and Endangered Species Present

The presence of spawning salmon or other spawning threatened and endangered species precludes any attempts to sample. The site should be recorded as "Visited-T&E species present" and the next alternate-list site sampled.

1.4.3.2.6.3 Non-wadeable

The reach length is not wadeable. BURP protocols were developed specifically for wadeable streams, so sites where the reach is non-wadeable should be marked as "Visited-Non-Wadeable" and the next alternate-list site sampled.

1.4.3.3 Sampleable Categories

If the site is sampleable, one of the following two categories should be recorded on the field form.

1.4.3.3.1 Wadeable

The stream can be sampled with wadeable stream protocols as per the BURP field manual.

1.4.3.3.2 Altered Channel

There is a stream at the location marked with the x-site on the map, but the stream channel does not appear the way it is drawn on the map. An example would be a channel that was re-routed following a flood event that cut off a loop of the stream. Establish a new x-site at the same relative position in the altered channel. Make careful notes and sketches of the changes on the field form.

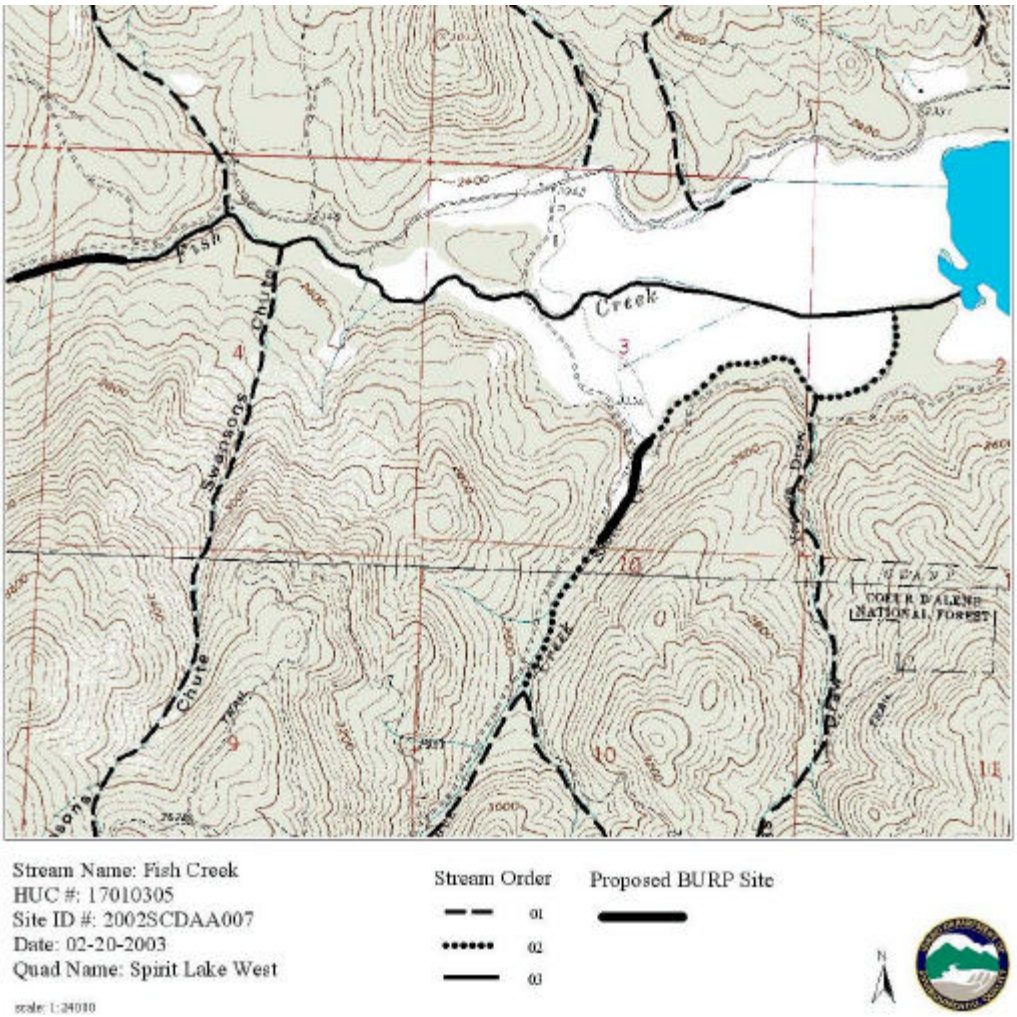


Figure 7. Topographic map section with site ID, scale and proposed BURP sites marked.

2 Preparing for BURP Field Activities

Preparing for field work includes determining property ownership of pre-selected sites, getting permission to access the property if it is private, pre-selecting different sites if permission is not granted, and gathering equipment and supplies. These steps are detailed below and shown in the Preparing box in Figure 8.

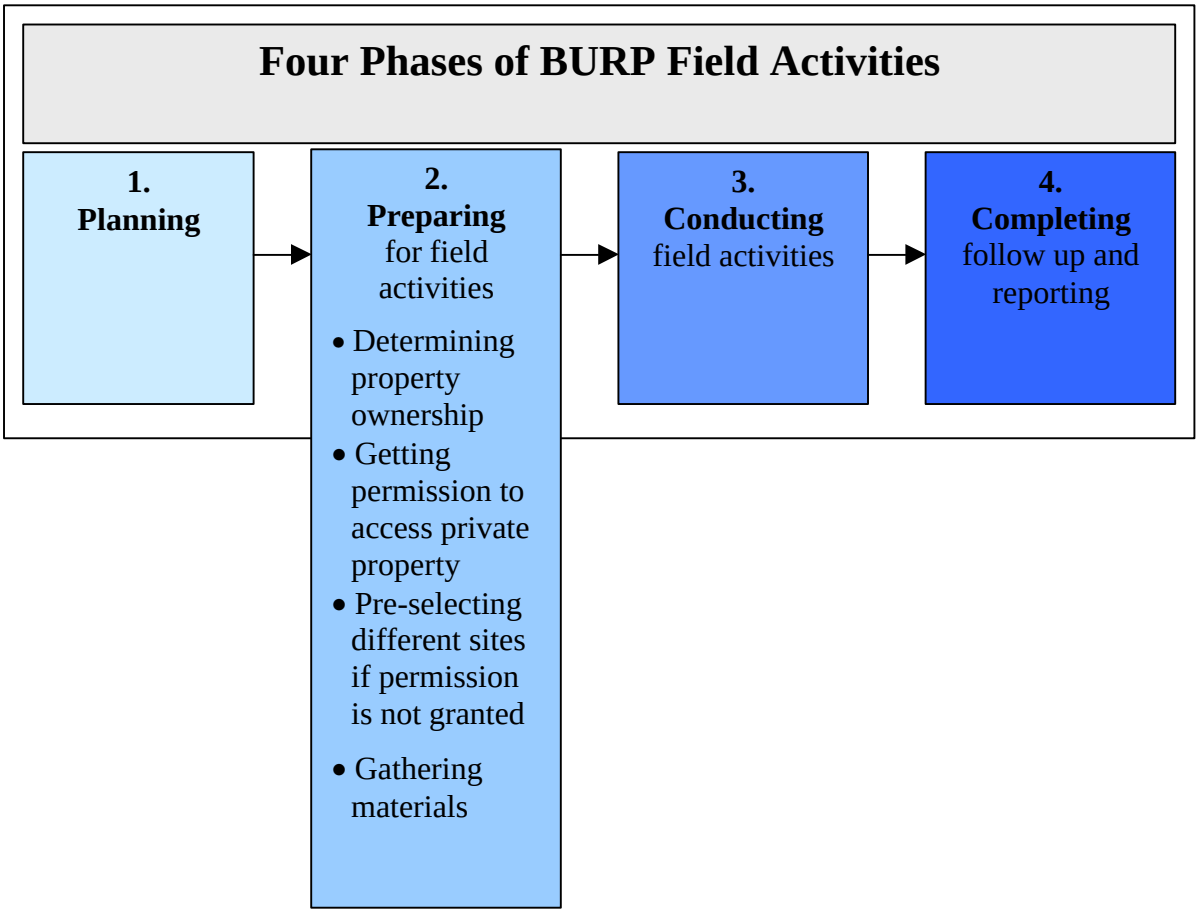


Figure 8. Steps in the Preparing for Field Activities phase.

2.1 Determining Property Ownership

The BURP Coordinator will identify and contact the property owner. Crew members may be required to make follow-up contacts. Establish that the contact is the appropriate authority for the property in question.

2.2 Getting Permission to Access Private Property

Each regional office is responsible for securing landowner permission to access private property for BURP monitoring. Follow the steps below to help ensure good working relationships with landowners whose cooperation allows comprehensive monitoring.

Contact the property owner either by phone or in person. According to BURP policy, the BURP Coordinator will make the initial contact. An optional informative "flyer" (see Appendix B) may be either mailed or hand-delivered to the appropriate party, but it cannot be substituted for getting permission by telephone or in person. A flyer is simply an informative tool that provides general information regarding the intent and purpose of BURP monitoring. The flyer should provide full DEQ contact information so that the landowner/representative could later call or write DEQ for more information or alert DEQ of any changes in the agreement, logistics, etc.

When talking with landowners, be courteous and honest while explaining the intent and purpose of the visit. It is important to answer their questions and assure them that BURP methods will not damage their property or the resource.

If permission is granted, but the site visit is scheduled for a later time (and it often is), inform the owner that you will contact them on or immediately before the day of the site visit (before going to the site). If they or their appropriate representative will be unavailable at that time, confirm that they are in full accordance with the visit.

In accordance with BURP policy, document landowner contact information must be documented. The Private Property Owner Contact Record shown in Figure 9 provides an easy way to document the landowner/contact's name, address, and phone number; the time, date, and place of the visit or telephone call; and the results of the visit or phone call (was permission granted or denied?). This record should be filled out while talking to the landowner or immediately after and then filed in the site or water body file.

Private Property Owner Contact Record
Beneficial Use Reconnaissance Program

Land Owner: Other Contact(s):

Ownership of property in question confirmed? ÿ Yes ÿ No
Address:

Phone Number: ( )
Date of Contact: Time of Contact: Contacted: ÿ By Phone ÿ In Person
Permission Granted: ÿ Yes ÿ No
Notes about accessing property (things to watch out for, avoid, etc.):

Directions to Property:

If site was visited, Thank You card sent on (date): .

Figure 9. Private Property Owner Contact Record.

If permission is granted and if the owner has time, ask questions about the site, particularly regarding site history and characteristics (fish sightings, typical high water levels, flooding events, etc.). This can be valuable information not readily available elsewhere. Let the owner know his knowledge and input are valued. As a general rule, listen more and talk less. Be sure to include this information in the Comments section of the field form.

2.3 If Permission Is Not Granted

Never argue or try to persuade if access is denied; simply thank the person and hang up the phone or leave the property and find another representative site.

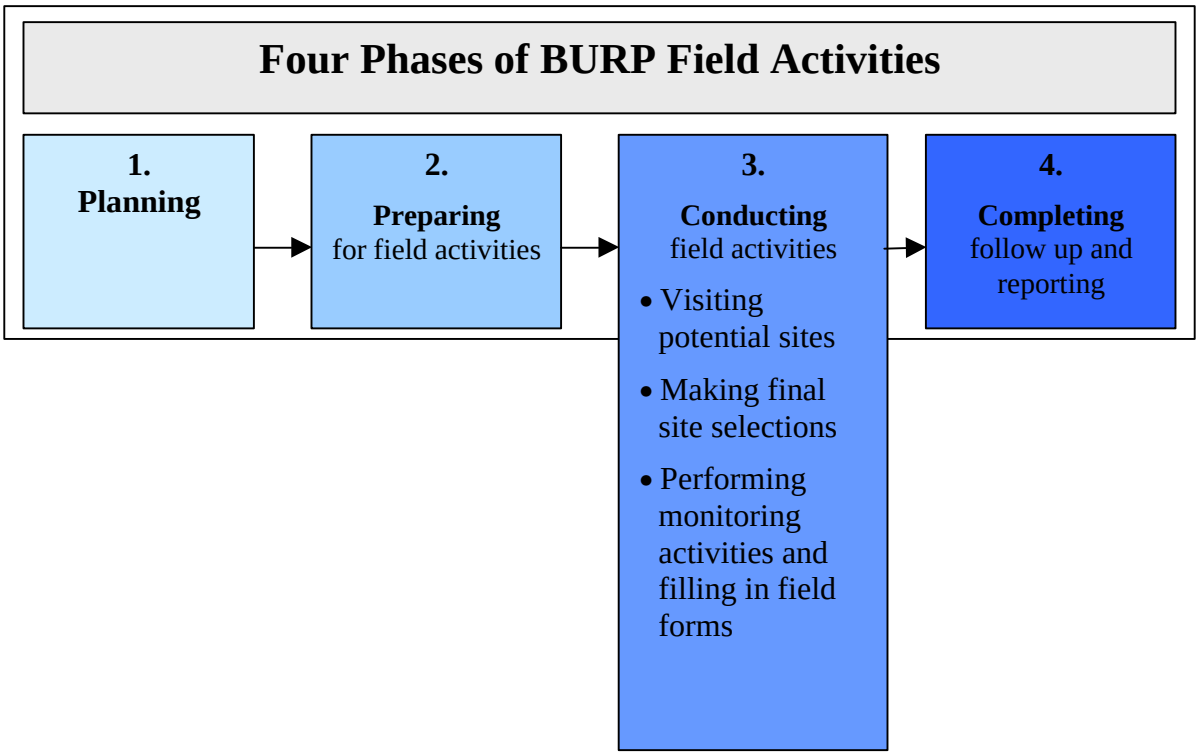
2.4 Gathering Materials

In the spring, BURP Coordinators gather and prepare the materials to be used during the field season, including paperwork, supplies, gear, and vehicles. Appendix C contains a checklist that can be used to ensure nothing is overlooked. The coordinators ensure vehicles and gear have received any necessary maintenance and that paperwork and supplies are available or will be available when needed.

3 Conducting BURP Field Activities

Conducting field activities includes visiting pre-selected sites and either verifying or changing site selections, performing monitoring activities and filling in field forms. These steps are shown in the Conducting box shown in Figure 10 and are detailed below.

Figure 10. Steps in the Conducting Field Activities phase.



3.1 Visiting Potential Sites

If a potential site is privately owned and permission to access it was granted more than two days ago, the landowner or representative should be contacted again to remind him or her of the planned visit and to confirm that you have permission. The BURP Coordinator will usually make this contact.

When accessing a site, always leave each gate as it was (open if it was open; closed if it was closed). Avoid livestock and on-site facilities whenever possible. If at all possible, avoid driving across soft terrain, as that often leaves damaging vehicle tracks. When placing site markers such as ribbons or stakes, note their locations so they can be removed when monitoring is complete.

3.2 Make Final Site Selections

Sampling sites pre-selected in the planning phase now have to be confirmed or changed. Upon reaching a site, ensure that it meets the water body size criteria for streams (see section 1.3.3) and that it is representative of the reach or entire stream (see section 1.4.1). If a pre-selected site is not appropriate, relocate to a more representative location. If a pre-selected site is not sampleable, follow the protocols in section 1.4.3. Mark the location of the site finally selected on the map created during the site pre-selection process (see section 1.4.2) and include the map and site selection document in the site file. Check.

3.3 Performing Monitoring Activities in the Field

Following the sequence below (illustrated in Figure 11 and outlined on the following two pages) is an efficient way to conduct a BURP survey. However, this sequence may be adjusted to meet the needs of individual crews. The illustration in Figure 11 shows the general layout of a typical BURP reach and indicates where within the reach each variable should be measured.

3.3.1 Recommended Sequence

1. Determine the appropriate reach for surveying. The length should be 30 times the general bankfull width or a minimum of 100 meters.

2. Measure the appropriate distance and mark beginning and ending points with flagging, being careful to stay out of the stream. The downstream end of the measured length is considered the beginning of the reach.

3. Take photographs of the site and record Photo Information on the Habitat Distribution and Photo Data page (see section 3.3.11.2).

4. Record global positioning system (GPS) coordinates and map location on the Site Identification page (see section 3.3.4.7). Mark the location on the map.

5. Fill out the information about the Location Relative to Landmark (see section 3.3.4.12) on the Site Identification page.

6. Complete the bacteria screening process (see section 3.3.15.1).

7. Collect bacteria samples if the screening process indicates it is necessary and the schedule can accommodate the sample holding time (30 hours) (see section 3.3.15.2).

8. Measure specific conductivity and temperature (see sections 3.3.4.10 and 3.3.5.9) and record them on the General Stream Data page.

9. Measure stream discharge in a location with a relatively straight channel and uniform flow, where possible (see section 3.3.12), and record on the Discharge Measurement page.

10. Locate the first riffle upstream from the beginning point and establish the first transect (T1). At T1, perform the following:
    a. Collect a macroinvertebrate sample (see section 3.3.6.1).
    b. Collect a periphyton sample (see section 3.3.6.2).
    c. Measure canopy closure (shade) (see section 3.3.8.2) and record on the Width, Depth, Canopy, Banks Data page.
    d. Conduct a pebble count immediately upstream from T1. Record the pebble count on the Substrate Data page (see section 3.3.7.1).

11. Go 10 meters above T1 and perform the following:
    a. Measure width and depth of the stream, and record on the Width, Depth, Canopy, Banks Data page (see section 3.3.8.1).
    b. Measure undercut banks if they are present, and record on the Width, Depth, Canopy, Banks Data page (see section 3.3.8.4).
    c. Measure canopy closure again, and record only in the Comments section on the Comments page. This additional canopy closure measurement is part of a pilot project and is not recorded in the main data sections of the field forms.

12. Proceed to a mid-site riffle habitat unit and establish the second transect (T2). Repeat macroinvertebrate collection, periphyton collection, pebble count, and canopy closure measurements and record on the appropriate pages of the field forms (see 10a–10d above).

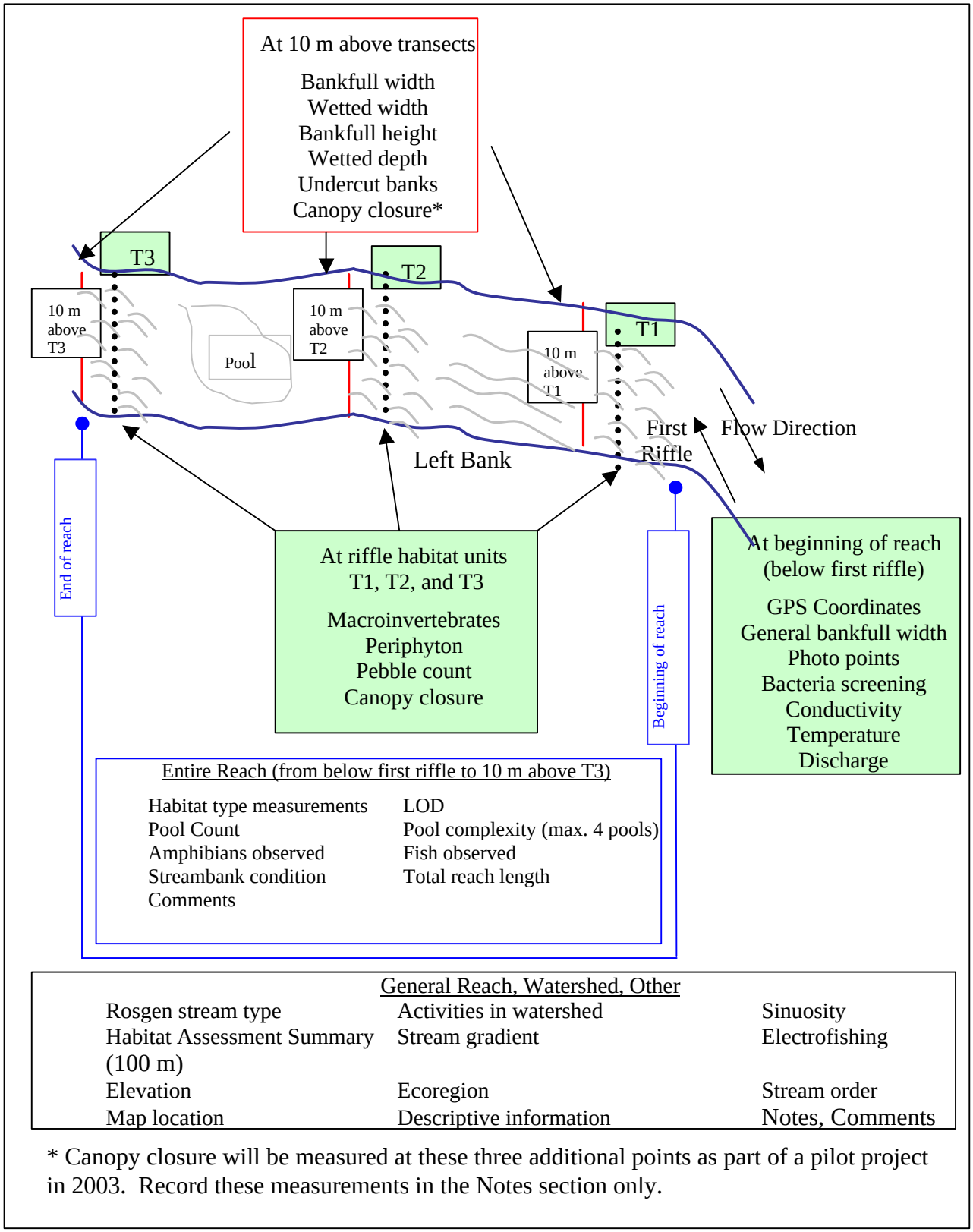
13. Go 10 meters above T2 and repeat width, depth, and any undercut banks measurements and record on the Width, Depth, Canopy, Banks Data page.

14. Measure canopy closure 10 meters above T2 and record only in the Comments section on the Comments page. This additional measurement is part of a pilot project and is not recorded in the main data sections of the field forms.

15. Proceed to an upper-site riffle habitat unit and establish the third transect (T3). Repeat macroinvertebrate collection, periphyton collection, pebble count, and canopy closure measurements and record on the appropriate pages of the field forms.

16. Go 10 meters above T3 and repeat width, depth, and any undercut banks measurements and record on the Width, Depth, Canopy, Banks Data page

17. Also measure canopy closure 10 meters above T3 and record only in the Comments section on the Comments page. This additional measurement is part of a pilot project and is not recorded in the main data sections of the field forms.



* Canopy closure will be measured at these three additional points as part of a pilot project in 2003. Record these measurements in the Notes section only.

Figure 11. A typical BURP reach, showing where each variable is measured.

18. Perform the following reach-wide measurements simultaneously as you move back down the reach. (In some cases, you may choose to do them as you work your way up the reach. This will usually be when the terrain is difficult, allowing you to move through the reach just once.)
    a. Conduct longitudinal habitat distribution measurements by characterizing and measuring pools, riffles, runs, and glides. (Hawkins et al. [1993] is helpful for making these distinctions.) Record on the Habitat Distribution and Photo Data page (see section 3.3.11.1). Calculate the total reach length and record it on the General Stream Data page (see section 3.3.5.2).
    b. Count large organic debris (LOD) (see section 3.3.10.2) and record on the Streambank Condition, LOD, Habitat Assessment Data page.
    c. Assess pool complexity at a minimum of three pools within the site. Follow the pool definition given as one of the habitat types (see section 3.3.11.1) to identify pools. Record on the Pools Data page. Also count the total number of pools throughout the reach and record on the Pools Data Page.
    d. Conduct a streambank condition (bank stability) survey by rating the amount of cover and stability of each bank (see section 3.3.10.1). Express this as percent of total length surveyed on the Streambank Condition, LOD, Habitat Assessment Data page.

19. When all other activities are completed, gather the crew and complete the Habitat Assessment Summary (see section 3.3.10.3) on the Streambank Condition, LOD, Habitat Assessment Data page.

20. Conduct fish sampling if it is to be done, using electrofishing (see section 3.3.14). Make note of fish and amphibians observed on the Biological Data page (see sections 3.3.6.3 and 3.3.6.4), even if none are collected or vouchered any.

21. Determine and record stream gradient (see section 3.3.5.3), Rosgen stream type (see section 3.3.4.4), stream order (see section 3.3.5.6), sinuosity (see section 3.3.5.7), and activities in the watershed (see section 3.3.5.8).

22. Decontaminate equipment and gear before leaving the site (see section 4.1.1).

23. Leave the site as it was (see section 4.2.1).

24. Contact the landowner (if possible) to thank her for allowing you access and to let her know you are finished and are leaving the site (see section 4.2.2).

3.3.2 Filling in and Handling BURP Field Forms

The BURP field forms are teleforms designed to be read by an electronic reader. They are reviewed in the regional office and then submitted to the state office for input to the BURP database. For both efficiency and data quality control, certain rules must be followed when filling out and handling these forms. The general rules, that apply to all forms, are listed below. Rules that apply only to individual fields are discussed in those sections.

3.3.2.1 General Rules for Filling In and Handling BURP Field Forms

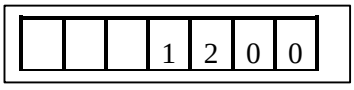
- Print legibly.
- Use a number 2 pencil.
- Fill in the Site ID on **all** pages (lower left corner).
- All alpha characters must be capital letters.
- Each cell must contain only one character.
- Keep all parts of each character, whether letter or numeral, entirely inside the box or cell.
- Do **not** put slashes through zeroes, sevens, or any other characters.
- Fill in or darken circles (radio buttons). They must be at least 80% filled. Do not put a check mark, X, or other mark in or through any circle.
- If the wrong circle is filled in by mistake, fill in the correct circle as well and circle it. Transcribe the form (make a new one that is correct) in the regional office before submitting it to the database manager in the state office.
- Do not spill anything on the forms. The electronic reader will try to interpret spots and blotches as data. This will slow down the process and might create quality control issues.

  Do not staple the pages. This creates marks or tears that cause problems with electronic readability.
- Ensure that the corner markers (four right angles, one in each corner of the page) stay intact (i.e., don't let corners of forms get torn or crumpled). The electronic reader has to "sight" all four corner markers to read the page correctly.
- Ensure that the "bar code" number (this is simply a 10-digit number, not a scanable bar code like those used in stores) in the upper left hand corner stays intact (i.e., don't let it get torn, crumpled, or marked). This is the key to accessing the form for reading the data.
- Print comments in the Comments section only (Page 10), not in the margins or anywhere else on the forms.

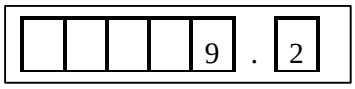
The following terms will be used in the rules given for individual fields on the field form pages:

- *Left Justified*
  Data begins in
  the left-most cells
  as shown

- *Right Justified*
  Data uses only the right-most cells as shown



- *Decimal Justified*
  Data is supplied in appropriate cells, with decimal pre-filled. Preceding zeroes are not required.



3.3.3 Data Fields on the BURP Field Forms

The next twelve subsections of this manual correspond to the ten pages of field forms, plus the fish data sheets and bacteria screening checklist. Each subsection begins with a sample of how a page of the field forms looks when it is filled in properly, displayed as a figure. This is followed by a discussion of each variable on that page, which may include a definition of the variable and a rationale for including it in BURP monitoring. The method or protocol used to measure or determine each variable is then described.

3.3.4 Site Identification Page

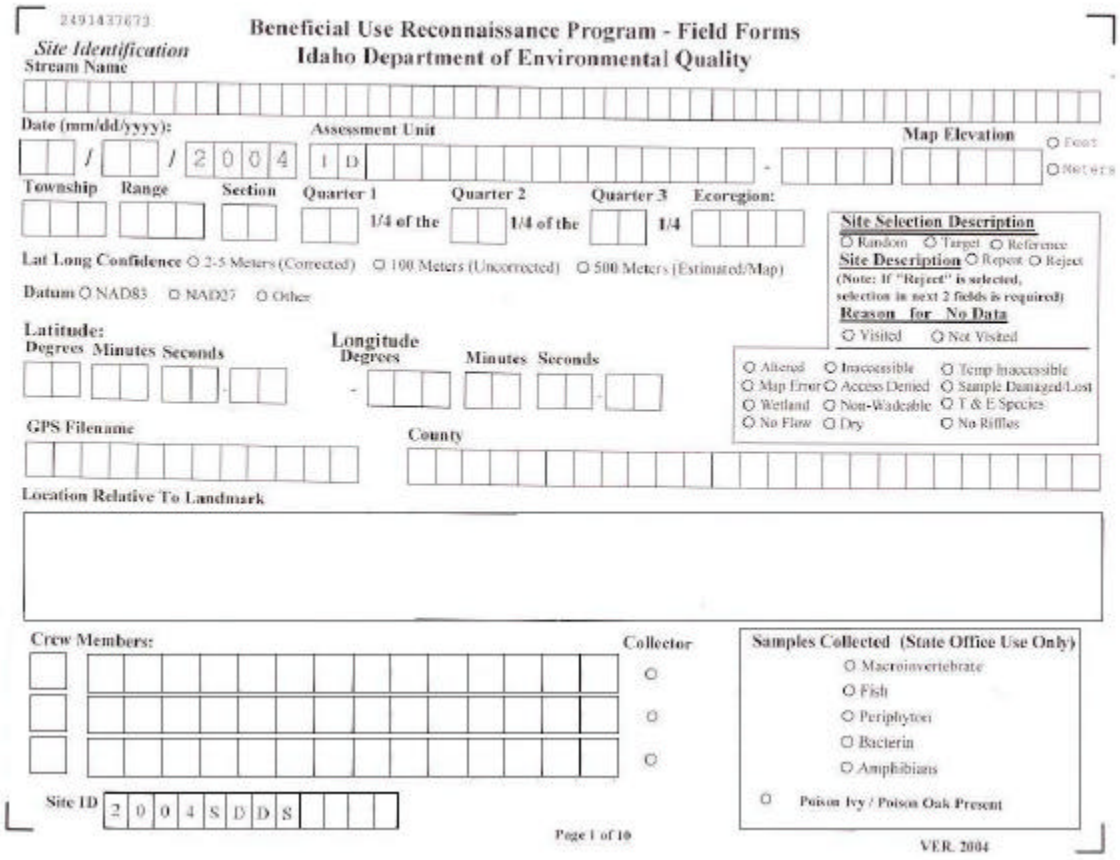


Figure 12. Site Identification page example.

3.3.4.1 Stream Name

It is critical that the correct name and location of the stream being monitored be consistently used (Meixler 1999). Different sources will often have different spellings for the same stream. Also, there can be many streams using the same name. For instance, there are 46 Bear Creeks and Rock Creeks in Idaho (U.S. Geological Survey 2000). BURP has adopted the USGS Geographic Names Information System (GNIS) (U.S. Geological Survey 2000) as the standard source for stream names for Idaho. Look up each stream name in the GNIS and verify the location and spelling. Use the properly spelled name on all BURP field forms, field notes, and labels concerning a particular monitoring site.

This is a left justified alphanumeric field. Leave unused cells blank

3.3.4.2 Date

The date format is YYYY/MM/DD, representing year, month, and day. As an example, July 21, 2003 is written as 2003/ 07/21. Fill all cells.

3.3.4.3 Hydrologic Unit Code (HUC)

This comes from a stream numbering system comprising the USGS 4th field hydrologic unit codes (HUCs). These numbers can be obtained from a GIS coverage or HUC map.

3.3.4.4 Assessment Unit (AU)

This is a left justified alphanumeric field. Leave unused cells blank.
The format is ID + HUC + Basin + Water Body ID _ + stream order (example below)

I	D	1	7	0	4	0	2	1	4	S	K	0	1	3		-	0	2		

- First two cells: the state code ("ID" for Idaho) is pre-printed on the form.
- Next eight cells: Fourth field HUC code. Use only numeric characters.
- Next two cells: Basin Code (example "SK" for Snake River Basin; see other codes below). Use only alpha characters.

  Basin codes:

  BR = Bear Basin (HUCs begin 1602 or 1601)

  CL = Clearwater Basin (HUCs begin 1706...)

  PN = Panhandle Basin (HUCs begin 1701...)

  SL = Salmon Basin (HUCs begin 1706...)

  SW = Southwest Basin (HUCs begin 1705...)

  SK = Snake River Basin (HUCs begin 1704...)

- Next four cells: Water Body ID. Use only numeric characters for the first three of these four cells; the fourth cell is for an optional* alpha character.
- One underscore/dash place holder is supplied.
- Next four cells: Stream Order Code. The first two of these four cells are mandatory numeric; the last two of these four cells are for optional* alpha characters.

*If the optional alpha character cells are not needed leave them blank as shown in the example above.

The AU is assigned by DEQ. If this is not already filled in on the field form, contact your BURP Coordinator. Based on latitude and longitude information, the AU can be filled in when the GIS shapefile is downloaded.

3.3.4.5 Map Elevation

Elevation is the height above or below sea level at a given point on the earth's surface, obtained from, or as depicted by, a topographical map. Identify elevation using a 1:24,000 topographic map, **not** a GPS unit.
This field is right justified. Leave unused cells blank. Designate feet or meters for units.

3.3.4.6 Public Land Survey Coordinates

Find public land survey coordinates on a 1:100,000 scale map and record them on the field form in the following order: township, range, section, quarter 1, quarter 2, and quarter 3 (quarter 1 on the field form is the smallest quarter on the map).

The diagram in Figure 13 shows an example of public land survey coordinates. A township is a division of territory in surveys of U.S. land containing 36 sections (36 square miles). A range is one of the north-south rows of townships in a U.S. public-land survey. Ranges are numbered east and west from the principal meridian of the survey. A section is a piece of land one square mile in area forming one of the 36 subdivisions of a township. Sections are divided into quarters. Quarters are further divided into smaller quarters.

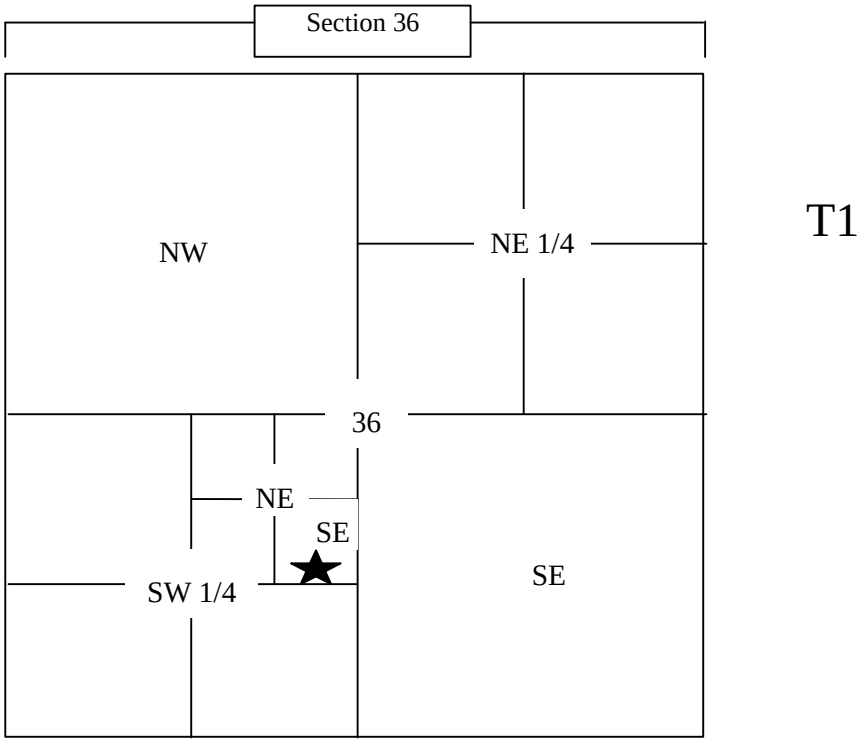


Figure 13. Example of public land survey coordinates.

3.3.4.7 Latitude and Longitude

Latitude and longitude are obtained from a GPS instrument. If the instrument is unable to get a reading, these coordinates can be simply appended to the final shape file in ArcView® or within the GPS file. Leave numbers initially written down uncorrected.
This is a decimal justified field.

3.3.4.8 Latitude Longitude Confidence

If the latitude and longitude have been differentially corrected, fill in the circle for 2-5 meters. If the data have not been differentially corrected, fill in the circle for 100 meters. If the GPS cannot get a reading, fill in the circle for 500 meters (estimate) indicating the values are derived from a map. All GPS instruments used for BURP surveys should be programmed for using NAD27 Datum. There may be unusual circumstances when other datums are necessary, in which case the BURP Coordinator will notify you of this change. Unless notified differently, fill in the circle for NAD27 on the field form.

3.3.4.9 GPS Filename

A GPS file name is required to identify the particular site. Use the default name provided by the GIS unit, assign a file name, or choose the site identification number from the data dictionary in the GIS unit. Use the same site identification number as on the field forms.

3.3.4.10 County

Record the county the site is located in.

3.3.4.11 Ecoregion

Ecoregions are areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components.

Identify the ecoregion the site is located within from an appropriate ecoregion map. Figure 14 is an example of a Level III ecoregion map for Idaho (McGrath et al. 2001).Figure 15 is an example of a Level IV ecoregion map.

Ecoregional boundaries are represented by lines on a map; however, these boundary lines may represent gradational changes rather than sharp changes in ecology. When a sample site is near an ecoregional boundary line, evaluate the ecoregion at the site rather than assigning the ecoregion strictly by boundary lines indicated on the map.

This field is left justified. Use alpha or numeric characters. Leave last cells blank if there are no data for them.

3.3.4.12 Location Relative to Landmark

Provide a site description based on permanent landmarks, such as roads, tributaries, and prominent features. The description should be sufficient for a return trip by someone who was not present on the initial trip.
This is a memo field; print legibly.

3.3.4.13 Crew Members

Record only the first initial (no period) and last name of each crew member, such as "S Woodhead." Fill in the circle next to the name of the crew member acting as collector for this site. The collector is the crew member responsible for collecting the macroinvertebrate and periphyton samples.

3.3.4.14 Samples Collected

Fill in the circle for each type of sample collected during the site visit.

3.3.4.15 Site ID (site identification)

Each site has its own unique site identification number. For example, for site 2002SLEWA001, 2002 represents the year, S means stream, LEW identifies the regional office, A identifies the "A" crew, and 001 are the numbers unique to the site. The next site that crew monitors will have its identification number ending with 002, followed by 003, and so on.

The site ID must be recorded on each individual field sheet.

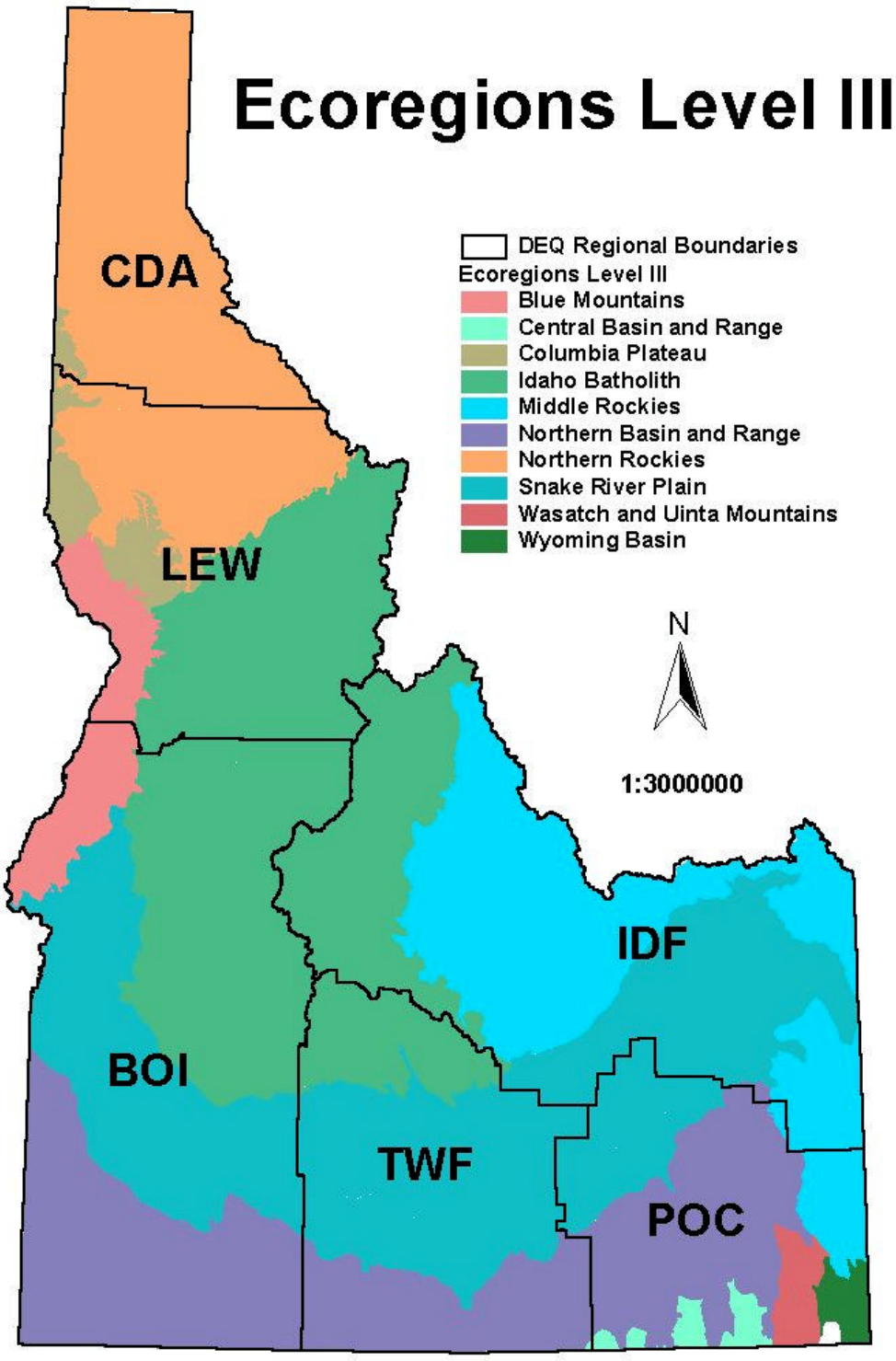


Figure 14. Example of a Level III ecoregion map for Idaho

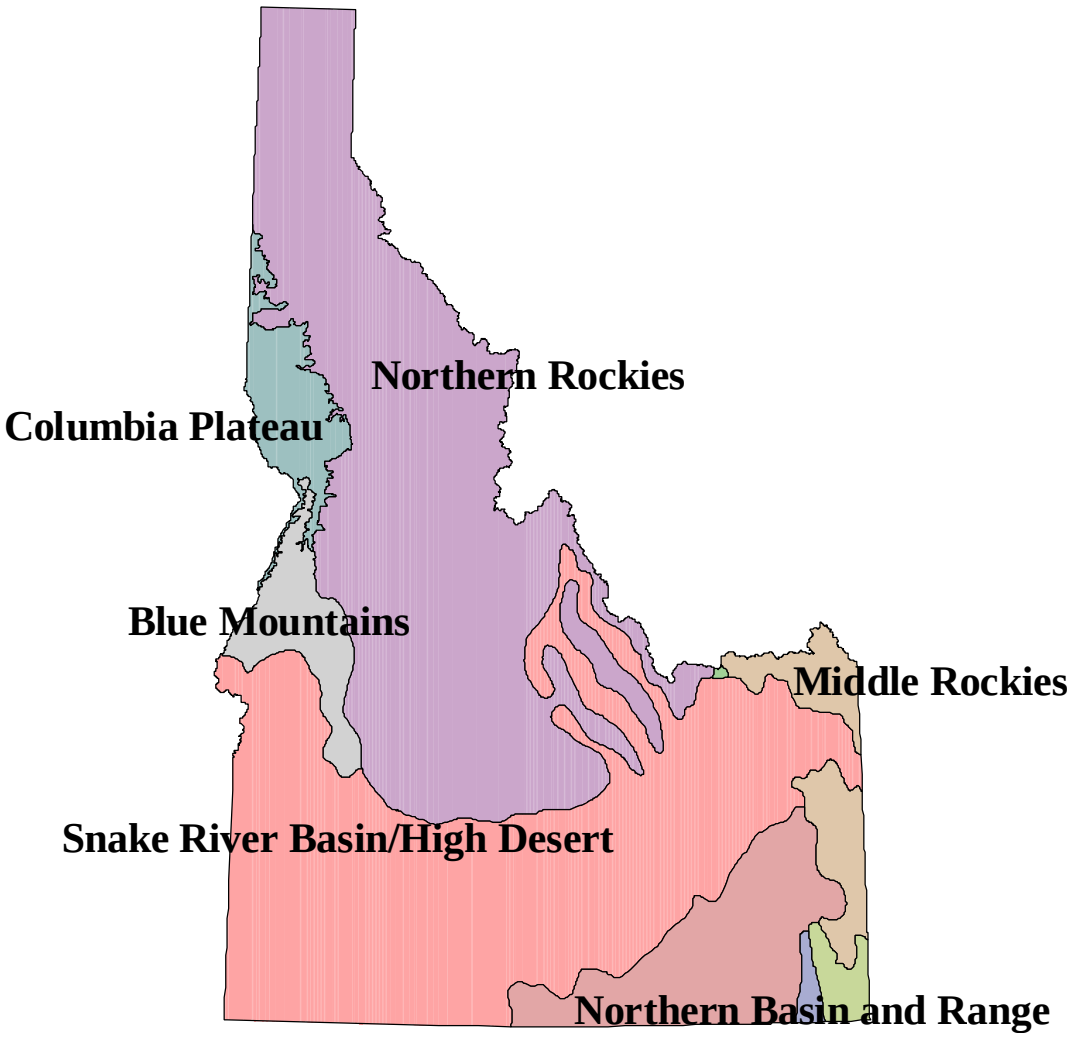


Figure 15. Example of a Level IV ecoregion map for Idaho.

3.3.5 General Stream Data Page

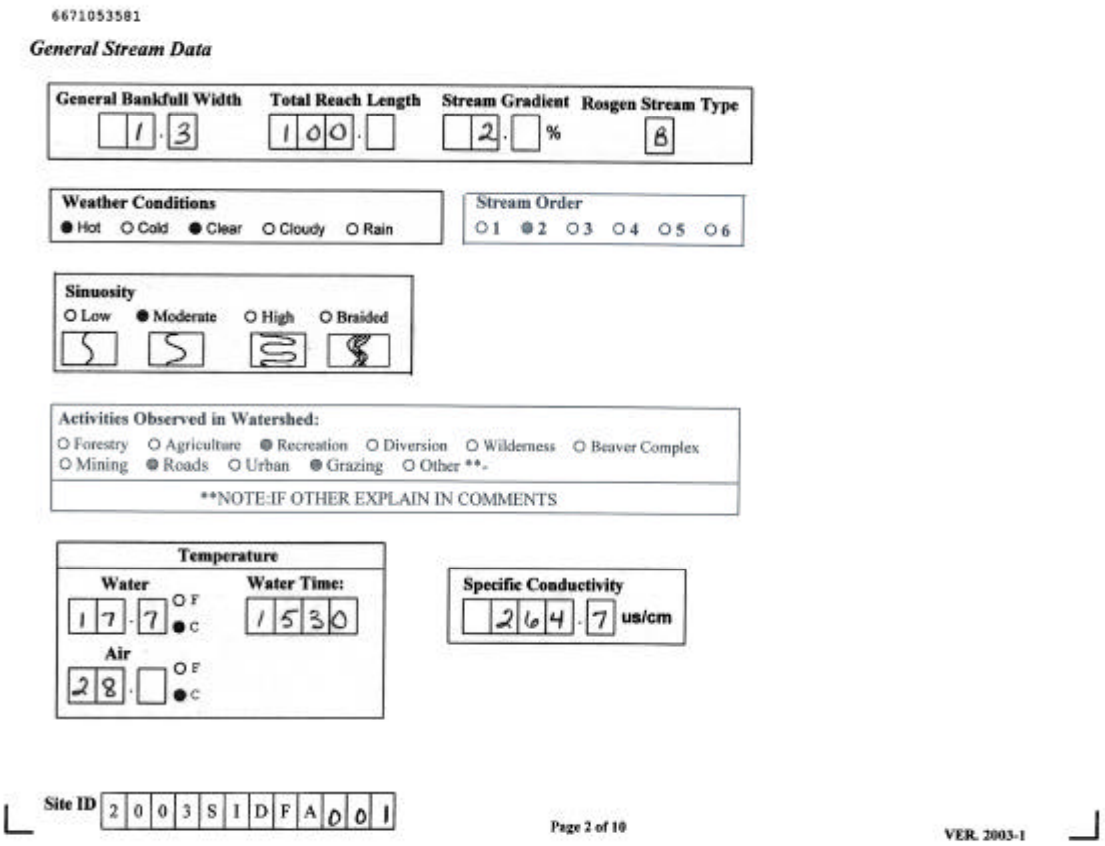


Figure 16. General Stream Data page example.

3.3.5.1 General Bankfull Width

The general bankfull width is the average channel width between the tops of the most pronounced banks on either side of a stream reach. Take several measurements, calculate the average, and record it on the field form. For further discussion regarding bankfull width, see section 3.3.8.1, Width/Depth Ratio, and Leopold et al. (1995).

This is a decimal justified field.

3.3.5.2 Total Reach Length

The total reach length is calculated as the sum of the individual lengths of segments classified as riffles, runs, pools, and glides. When initially laying out the reach, the length must be either 30 times the general bankfull width or a minimum of 100 meters, whichever is greater.

This is a decimal justified field.

3.3.5.3 Stream Gradient

BURP uses gradient as a measurement of the slope of the water's surface. Stand so that the bottom of your feet are level with the water's edge. Measure the gradient with a clinometer sighted as far upstream or downstream as feasible at an object the same height (your eye level) as the clinometer. Often two people work together: one holds a horizontal two-meter rod held at the sighter's eye level, while the second person sights on the rod with the clinometer. Alternatively, use the clinometer to sight on a ribbon tied at eye level upstream or downstream. If the distances are relatively short, take three readings and average them.

This is a decimal justified field.

3.3.5.4 Rosgen Stream Type

Under this system, streams are grouped according to geomorphic structure, water source, associated biota, or other characteristics.

Streams in Idaho exhibit considerable variability in climates, hydrology, geology, land forms, and soils. Recognizing this, the BURP Technical Advisory Committee elected to use Rosgen's (1996) Stream Classification System, Level I, to potentially characterize streams for comparison. As Conquest et al. (1993) noted, "One way to organize an inherently variable landscape is to employ a system of classification. The general intent of the classification is to arrange units into meaningful groups in order to simplify sampling procedures and management strategies."

Determine the Rosgen stream type to Level I only. First determine the following:

- amount of erosion
- amount of deposition
- channel shape (see cross-sectional view from DEQ flip chart)
- gradient
- sinuosity
- width/depth ratio

Compare this information with the illustrations in Figure 17 and the corresponding descriptions in Table 3 to help determine Rosgen stream type.

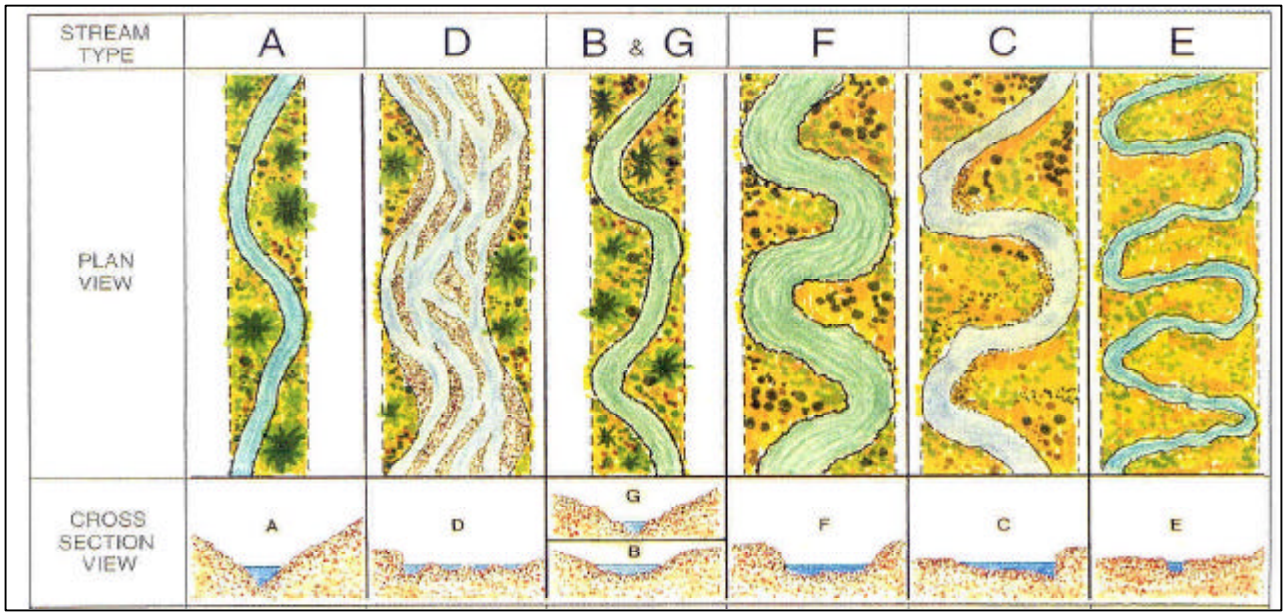


Figure 17. Rosgen Stream Type illustrations and descriptions.

(Rosgen Stream Type Illustrations and Descriptions adapted from Rosgen 1996, used with permission).

Table 3. Description of Rosgen Stream Types.

Rosgen Stream Type	A	D	B and G	F	C	E
Gradient	4-10%	<4%	2-4%	<2%	<2%	<2%
Description	Steep, entrenched, cascading, step/pool streams. High energy debris transport associated with depositional soils. Very stable if bedrock- or boulder-dominated channel.	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.	B channel: moderately entrenched, moderate gradient, riffle dominated, with infrequently spaced pools. Very stable banks. G channel: entrenched "gully" step/pool and low width/depth ratio on moderate gradient.	Entrenched, meandering, riffle/pool channel on low gradients with high width/depth ratio.	Low gradient, meandering, point-bar, riffle/pool, alluvial channel with broad, well defined flood plain.	Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.

3.3.5.5 Weather Conditions

Fill in the circle for any of the conditions existing during the site visit. If none apply, do not mark any. This is a multiple selection field; more than one circle can be marked.

3.3.5.6 Stream Order

Stream order is a hierarchical ordering of streams based on the degree of branching. As shown in Figure 18, a first-order stream is an unforked or unbranched stream. Two first-order streams flow together to form a second-order stream, two second-order streams combine to make a third-order stream, etc. Use a 1:100,000 map to determine stream order. This is a single selection field, choose only one.

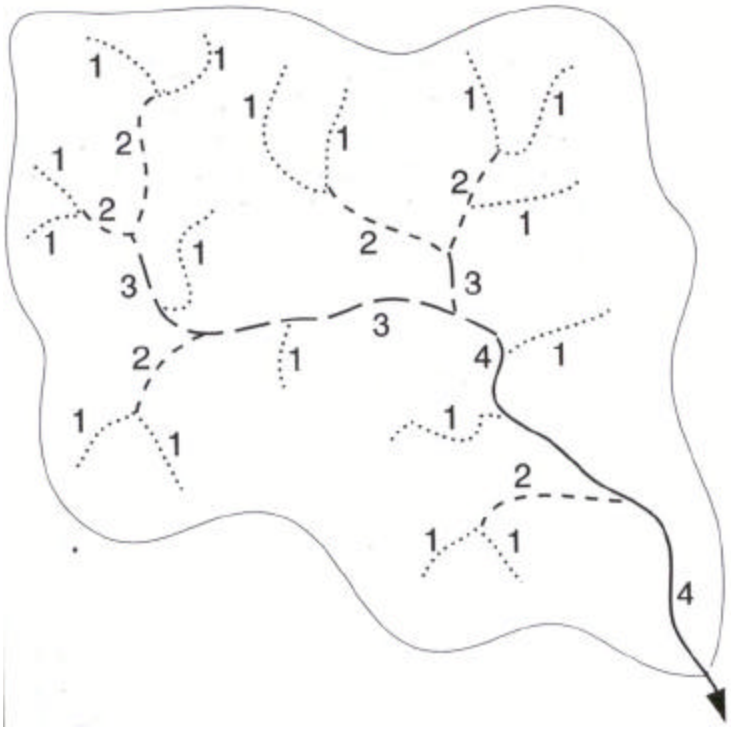


Figure 18. Stream orders.

3.3.5.7 Sinuosity

Sinuosity is the ratio between channel length between two points in a channel and the straight line length between the same two points.
Channels with sinuosities of 1.5 or more are called “meandering,” while those close to 1.0 are called “straight.”

This is a single selection field, only choose one.

3.3.5.8 Activities Observed in Watershed

Fill in the circle for any of the listed activities observed in the watershed and give additional information on the Comments page of the field forms. This is a multiple selection field; more than one activity can be selected.

3.3.5.9 Temperature

Zaroban (2000) pointed out that a number of factors influence water temperatures in streams. Stream water temperatures are influenced by water source, ground water, precipitation runoff, solar radiation (including shading), air temperature, climate, and geologic setting (Stevens et al. 1975). These factors must be considered in the design of any water temperature study, placement of temperature sensing devices, and interpretation of temperature data. Methods to help standardize surface water temperature monitoring and reduce sampling variability have been recommended (Stevens et al. 1975, Essig 1998, Water Quality Interagency Workgroup for the Oregon Plan 1998). Essig (1998) summarized a close relationship between air and stream temperature shown by several scientists[1]. Consequently, DEQ collects both air and water temperature data.

Water

Take the water temperature in a shaded spot in the stream using a calibrated thermometer. Be sure the water is adequately mixed and not influenced by localized warm or cool water sources such as ground water, point sources, or direct sunlight. Shaded sites with moderately turbulent flows, such as the tailouts of lateral scour and plunge pools, are good locations. Leave the thermometer in the water several minutes until it stabilizes before you take a reading.
This is a decimal justified field. Fill in the circle indicating whether the reading is Celsius or Fahrenheit (Celsius is preferred).

Water Time

Record the time the water temperature was taken in military time (i.e., 1:00 pm is 1300).

Air

Using a calibrated thermometer, take the air temperature at the bottom of the reach in the riparian zone. The thermometer should be placed in the shade about one meter high. Use either a hand-held thermometer or the temperature sensor on a specific conductivity or dissolved oxygen meter. Take the air temperature first while the thermometer is dry.

This is a decimal justified field. Fill in the circle indicating whether the reading is Celsius or Fahrenheit.

[1] Essig (1998) summarized what several scientists have shown to be a close relationship between air and stream temperature, citing Collins (1925), Mangan (1946), Moore (1967), Smith and Lavis (1975), Smith (1981), Crisp and Howson (1982), and Sinokrot and Stefan (1994).

3.3.5.10 Specific Conductivity

Conductivity is defined as a measure of the ability of a solution to carry an electrical current (Armantrout 1998). Conductivity is measured as micromhos per centimeter (µmhos/cm) or microsiemens per centimeter (Armantrout 1998).

Conductivity is dependent on the total concentration of ionized substances dissolved in the water. Elements whose ionic forms contribute the most to these measures include calcium, magnesium, sodium, potassium, bicarbonate, sulfate, and chloride. Solutions of most inorganic compounds are relatively good conductors. Conversely, molecules of organic compounds that do not dissociate in aqueous solution conduct a current very poorly, if at all (Franson 1998).

Several sources discuss the usefulness of conductivity data. Kunkle et al. (1987) found conductivity to be an useful indicator of mining and agricultural effects. Royer and Minshall (1996) found sites designated as degraded generally had higher conductivity values. Maret et al. (1997) reported conductivity is one environmental factor determining the distribution of fishes. Davis et al. (2001) report that conductance is an important water quality measure because the data can be used to estimate the total dissolved solids in the water. The conductivity of the water is important to electrofishing efforts (Reynolds 1983, 2000; Kolz 1993). Reynolds (1983) notes that a freshwater conductivity range of 100-500 µmhos/cm is best for electrofishing.

The conductivity of potable waters in the United States ranges generally from 50 to 1,500 µmhos/cm (Franson 1998). Hem (1985) reports the range of conductance values for natural ground and surface waters range from 50 µmhos/cm to 50,000 µmhos/cm or more. Values of 2 to 41 µmhos/cm have been reported for melted snow in the western United States (Hem 1985).

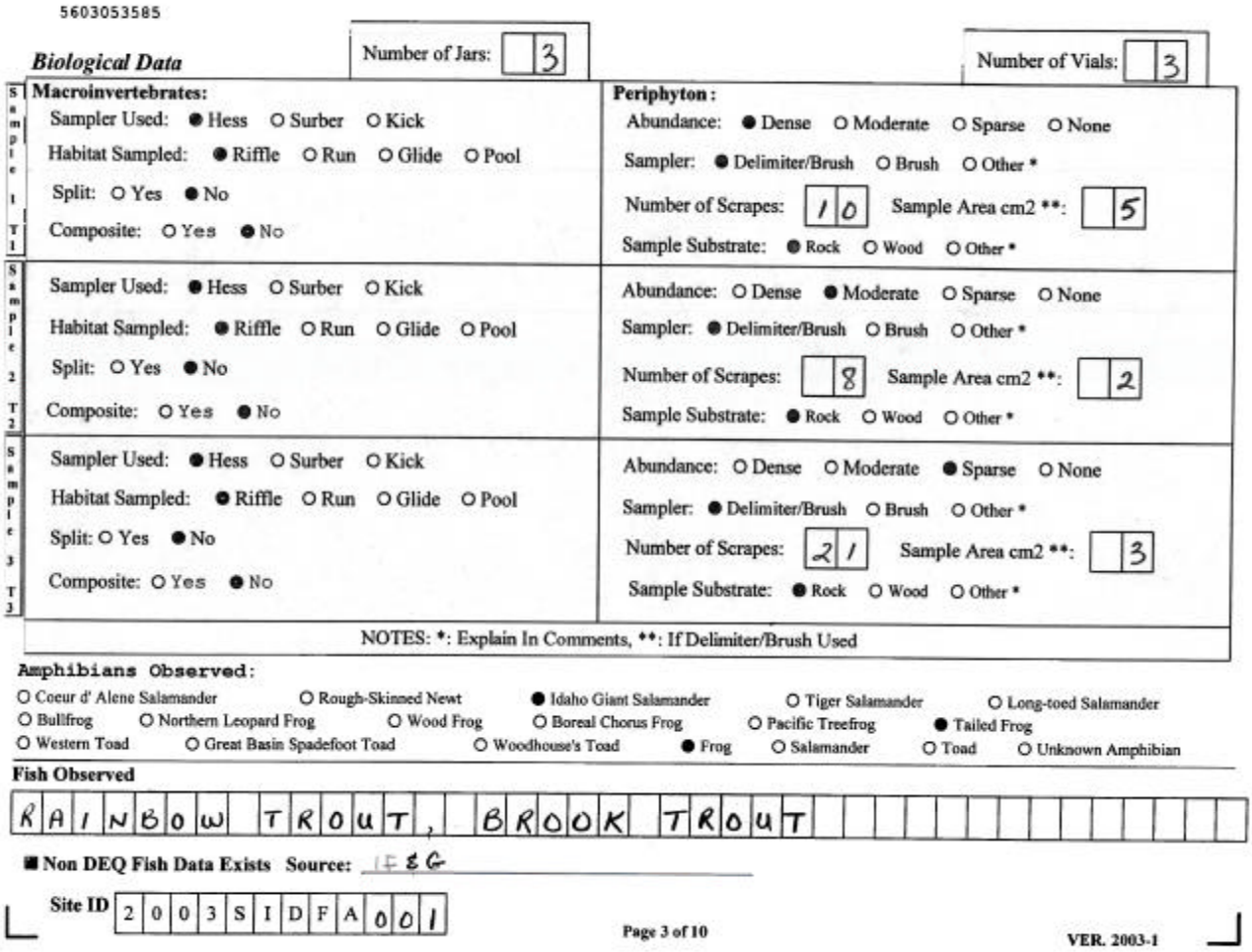
Before measuring conductivity, ensure that the meter is clean, in good working condition, and calibrated. Always transport the instrument in a protective carrying case. Use fresh batteries and carry a spare set of batteries and/or a backup meter. Keep a log book with the meter and record all calibrations, maintenance, and repairs. Follow the manufacturer's recommendations concerning cleaning and storing the meter.

Measure conductivity at T1 using a calibrated conductivity-temperature meter. Calibrate the instrument using a calibration solution within the same range of conductivity as the streams being monitored.

Place the meter in flowing water at mid depth. If using the YSI model 30, be sure the "ºC" indicator on the machine **is blinking**, indicating the instrument is measuring specific conductivity. Specific conductivity must be measured in the field (Radtke et al. 1998) to be reliable. For in situ measurements, which are recommended, immerse the conductivity and temperature sensors in the water a minimum of one minute to allow the sensors to equilibrate to water conditions. Record the conductivity (in microsiemens per centimeter at 25 °C) and temperature on the field form without removing the sensors from the water. Record conductivity measurements to three significant figures and use whole numbers only. This is a decimal justified field.

Rinse the sensor in deionized water and store it properly.

3.3.6 Biological Data Page



5603053585

Biological Data Number of Jars: 3 Number of Vials: 3

Sample 1 T1
Macroinvertebrates:
Sampler Used: ● Hess ○ Surber ○ Kick
Habitat Sampled: ● Riffle ○ Run ○ Glide ○ Pool
Split: ○ Yes ● No
Composite: ○ Yes ● No

Periphyton:
Abundance: ● Dense ○ Moderate ○ Sparse ○ None
Sampler: ● Delimiter/Brush ○ Brush ○ Other *
Number of Scrapes: 10 Sample Area cm2 **: 5
Sample Substrate: ● Rock ○ Wood ○ Other *

Sample 2 T2
Sampler Used: ● Hess ○ Surber ○ Kick
Habitat Sampled: ● Riffle ○ Run ○ Glide ○ Pool
Split: ○ Yes ● No
Composite: ○ Yes ● No

Abundance: ○ Dense ● Moderate ○ Sparse ○ None
Sampler: ● Delimiter/Brush ○ Brush ○ Other *
Number of Scrapes: 8 Sample Area cm2 **: 2
Sample Substrate: ● Rock ○ Wood ○ Other *

Sample 3 T3
Sampler Used: ● Hess ○ Surber ○ Kick
Habitat Sampled: ● Riffle ○ Run ○ Glide ○ Pool
Split: ○ Yes ● No
Composite: ○ Yes ● No

Abundance: ○ Dense ○ Moderate ● Sparse ○ None
Sampler: ● Delimiter/Brush ○ Brush ○ Other *
Number of Scrapes: 21 Sample Area cm2 **: 3
Sample Substrate: ● Rock ○ Wood ○ Other *

NOTES: *: Explain In Comments, **: If Delimiter/Brush Used

Amphibians Observed:
○ Coeur d' Alene Salamander ○ Rough-Skinned Newt ● Idaho Giant Salamander ○ Tiger Salamander ○ Long-toed Salamander
○ Bullfrog ○ Northern Leopard Frog ○ Wood Frog ○ Boreal Chorus Frog ○ Pacific Treefrog ● Tailed Frog
○ Western Toad ○ Great Basin Spadefoot Toad ○ Woodhouse's Toad ● Frog ○ Salamander ○ Toad ○ Unknown Amphibian

Fish Observed
RAINBOW TROUT, BROOK TROUT

■ **Non DEQ Fish Data Exists Source:** IDFG

Site ID 2003SIDFA001

Page 3 of 10 VER. 2003-1

Figure 19. Biological Data page example.

3.3.6.1 Macroinvertebrates

A macroinvertebrate is an animal without a backbone large enough to be seen without magnification and to be retained by a screen with 0.595-mm mesh (U.S. #30) (Armantrout, 1998).

Sampling for macroinvertebrates is an essential part of the BURP process. This biological assemblage reflects the overall ecological integrity of a stream. Because most streams are monitored infrequently, chemical monitoring is not always representative of the long-term condition of the stream. The biological community is exposed to the stream's condition over a long period of time, and therefore provides an integrated representation of water conditions and better classification of support status. Macroinvertebrates are an useful assessment tool because

they are ubiquitous, include numerous species, and respond to physical and chemical impacts in the water column (Rosenberg and Resh 1993). Additionally, macroinvertebrates with certain environmental tolerances may provide some insight regarding pollutants (Johnson et al. 1993).

BURP collects macroinvertebrate samples from three separate riffle habitat units (T1, T2, and T3) spread evenly through the reach, following Clark and Maret (1993). In a typical BURP survey, the person who collects macroinvertebrates also collects periphyton either before or immediately after collecting the macroinvertebrates.

To collect macroinvertebrates at each transect (T1, T2, and T3), first randomly select a location for macroinvertebrate sampling by generating two random numbers and using one as the lateral distance along the streambank to go upstream and the other as the perpendicular distance to go out across the stream. Place the sampler in this location. If the randomly chosen site does not provide an adequate seal or sample, move the sampler as much as one meter in any direction to improve sample collection.

Using a sampler (Hess is preferred but other types may be used) with a 500-micron size net (Hayslip 1993, Barbour et al. 1999), collect a macroinvertebrate sample. Brush all rocks and stir the substrate for a minimum of two minutes. Strive for a consistent time of three to five minutes per sample. Place the scrubbed rocks in front of the sampler net. Stir the substrate to a depth of 10 cm with a metal rod. Take care not to damage the macroinvertebrates during all phases of sample collection. Handle all macroinvertebrate samples (in the field) over a white pan, including transferring the sample from the net to the sample container. If any of the sample gets into the white pan, wash it into the sample bottle with ethyl alcohol (ETOH). (See Appendix D for a material safety data sheet [MSDS] for ethyl alcohol.)

Place the sample into a container, label it inside and out, and preserve with no less than 95% ethanol (the container should be filled to the shoulder). If a container is greater than 50% full of sample material, the contents should be divided into two containers (a split sample). If a single sample is divided into more than one container, be sure the sample labels and field data forms clearly reflect the sample identity. If more than one container is used, **each label** must state which container this is out of how many total—for example: 1 of 3, 2 of 3, and 3 of 3. As a minimum, each label must contain 1) stream name, 2) date, 3) site ID, 4) collector's name, and 5) jar count (e.g., 1 of 3, 2 of 3). After closing each sample container, gently invert it to mix the sample with the alcohol. Repeat this collection procedure at T2 and T3.

On the field form, fill in the total number of sample jars for the site (a right justified field), the type of sampler used, the habitat sampled, and whether the sample was split or composited (entire sample in one jar). Sampler Used, Habitat Sampled, Split, and Composite are single selection fields; choose only one in each field.
After sampling the reach, thoroughly rinse all brushes, nets, and other items that have come in contact with the sample. Examine them carefully and remove any algae or other debris. Examine all equipment again before using it at the next BURP site and reclean it if necessary to avoid sample contamination.

For the sample labels, use archival grade heavy paper that can withstand storage in alcohol (such as Resistall Paper 36#). Use an alcohol-proof ink pen or pencil for writing the field information on the label. Put one label inside the jar in addition to taping a label to the outside of the jar. After they have been identified and returned to DEQ, BURP specimens are deposited in the Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell. These specimens are then available for any later verification that might be needed and for future research opportunities.

3.3.6.2 Periphyton

Periphyton is attached microflora growing on the bottom of the stream or on other submerged substrates, including higher plants.

Periphyton is an useful indicator because of its wide distribution, numerous species, and rapid response to disturbance (Barbour et al. 1999). Periphyton integrates physical and chemical impacts because it exists in the water column. Diatoms, a type of periphyton, have frequently been identified as useful biological indicators, particularly in Montana, Kentucky, Oklahoma, and European countries (Round 1991, Rosen 1995). Periphyton information supplements fish and macroinvertebrate information because of differences in trophic levels, motility, and life history (Allen 1995). Additionally, if current fish information is unavailable for a particular stream, there will still be data from two other biological assemblages (if both periphyton and macroinvertebrates are collected) to determine aquatic life support status.

Collect periphyton samples from three separate riffle habitats (T1, T2, and T3), just above where the sampler was placed. Use a modified 30-cc syringe and a small, stiff-bristled brush. Randomly choose a stone from the wetted stream channel and carry it to the bank, making sure that the portion of the stone that was exposed to the sun remains on top. If no stone is available, use a piece of submerged wood, debris, or other hard surface. Firmly press the modified syringe over the stone and add a small amount of water using an aspirator or eye dropper. Place the brush into the syringe and scrub the surface of the stone until the attached algae are loose. When the algae have been sufficiently dislodged from the rock, use the aspirator to remove the mixture and place it into a 50-ml scintillation vial. Fill the vial to 40 mL and preserve by filling the remainder of the vial with 10% formalin to a volume of 50 mLs.

In a typical BURP survey, the person who collects macroinvertebrates also collects periphyton either before or immediately after collecting the macroinvertebrates

Combine the samples from all three riffles into a composite sample. If the periphyton are sparse, scrape the rock more than once to collect an adequate sample. Be sure to note the number of scrapes on the field form and, if necessary, separate the composite sample into two or more containers. Also note the abundance and type of substrate. If the substrate was something other than rock or wood, fill in the circle for “other,” and describe in the Comments section. Number of Vials, Number of Scrapes, and Sample Area are right justified fields, for numeric characters only. Abundance, Sampler, and Sample Substrate are single selection fields; choose only one in each field.
Ensure that 1% of the total sample volume is preserved with 10% formalin. (see Appendix D for an MSDS for formalin, and Appendix E for additional formalin handling information).

Labels must include, at a minimum: 1) stream name, 2) site ID, 3) date, 4) collector's name, and 5) vial count (e.g., 1 of 3, 2 of 3).

Label all sample containers (centrifuge tubes/vials) with labels printed on archival grade heavy paper that can withstand storage in formalin solution (such as Resistall Paper 36#), using an alcohol-proof ink pen or pencil to write on the label. Tape a label to the outside of the vial.

When the monitoring season is over, send all periphyton samples to the Water Quality Division in the DEQ state office (currently, to Cyndi Grafe).

3.3.6.3 Amphibians Observed

An amphibian is:

1) A cold-blooded, smooth-skinned vertebrate of the class Amphibia, such as a frog or salamander, that characteristically hatches as an aquatic larva with gills. The larva then transforms into an adult having air breathing lungs (Horton 2001).

2) An animal capable of living both on land and in water (Horton 2001).

Amphibians are in apparent decline (Corn 1994, Heyer et al. 1994, Mattoon 2000, Reaser 2000, Thomas 2001) and may be important water quality indicators (Heyer et al. 1994). For these reasons, BURP keeps records of amphibians observed at monitoring sites.

Fill in appropriate circles for amphibians observed within the survey area[2]. This is a multiple selection field, choose all that apply. It is recommended that a separate log of all amphibians observed be kept that includes species, numbers, and whether they are adult or juvenile. Any observations of amphibian deformities should be recorded in the Comments section of the field forms. Use DEQ's laminated ID flip charts to assist with identification.

Vouchering amphibians is optional[3]. It is recommended that a few voucher specimens of each taxon from each study site be collected to help DEQ verify the amphibian distribution in Idaho. Amphibians can be killed in weak ethyl alcohol solutions, in hot water. If these methods/agents are not available the amphibians can be killed in a 10% formalin solution. This can be done in an opaque plastic bottle. The specimens should be preserved in a 10% formalin solution. If the specimen is large, make a small incision in the body wall (ventral side) to allow for proper internal preservation. Later (in the museum) the specimens will be transferred into 70% ethyl alcohol.

---

[2] Field identifications can be made using Peterson et al. (1996). Additional publications which help with the identification and distribution of amphibians in Idaho include Behler and King (1997), Fichter and Linder (1964), Linder and Fichter (1977), Nussbaum et al. (1983), and Stebbins (1985), Wilson (1975) and Groves et al. (1997). Several other guides to the amphibians of adjacent areas may prove useful and include Baxter and Stone (1985), Corkran and Thoms (1996), Koch and Peterson (1995), Leonard et al. (1993), and Reichel and Flath (1995).

[3] Recent publications concerning the sampling of amphibians include Corn and Bury, (1990), Bury and Corn (1991), Hyer et al. (1994), Olson et al. (1997), and Olson (1999).

Amphibian voucher specimens are deposited in the Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell. The information is shared with the Idaho Museum of Natural History, Idaho State University, Pocatello.

3.3.6.4 Fish Observed

Record all general fish observations. This is not a replacement for fish collection and identification discussed later in this manual. However, if fish collection is prohibited, noting your observations here is especially important.

Leave one blank cell for a space when there is more than one word in the species name (e.g., rainbow trout, brook trout). Put a comma in one cell and leave one cell blank between fish species. This is a left justified field, for alpha or numeric characters.

3.3.6.5 Non-DEQ Fish Data

This section is filled in by the BURP Coordinator or other office staff and is not related to field data.

3.3.7 Substrate Data Page

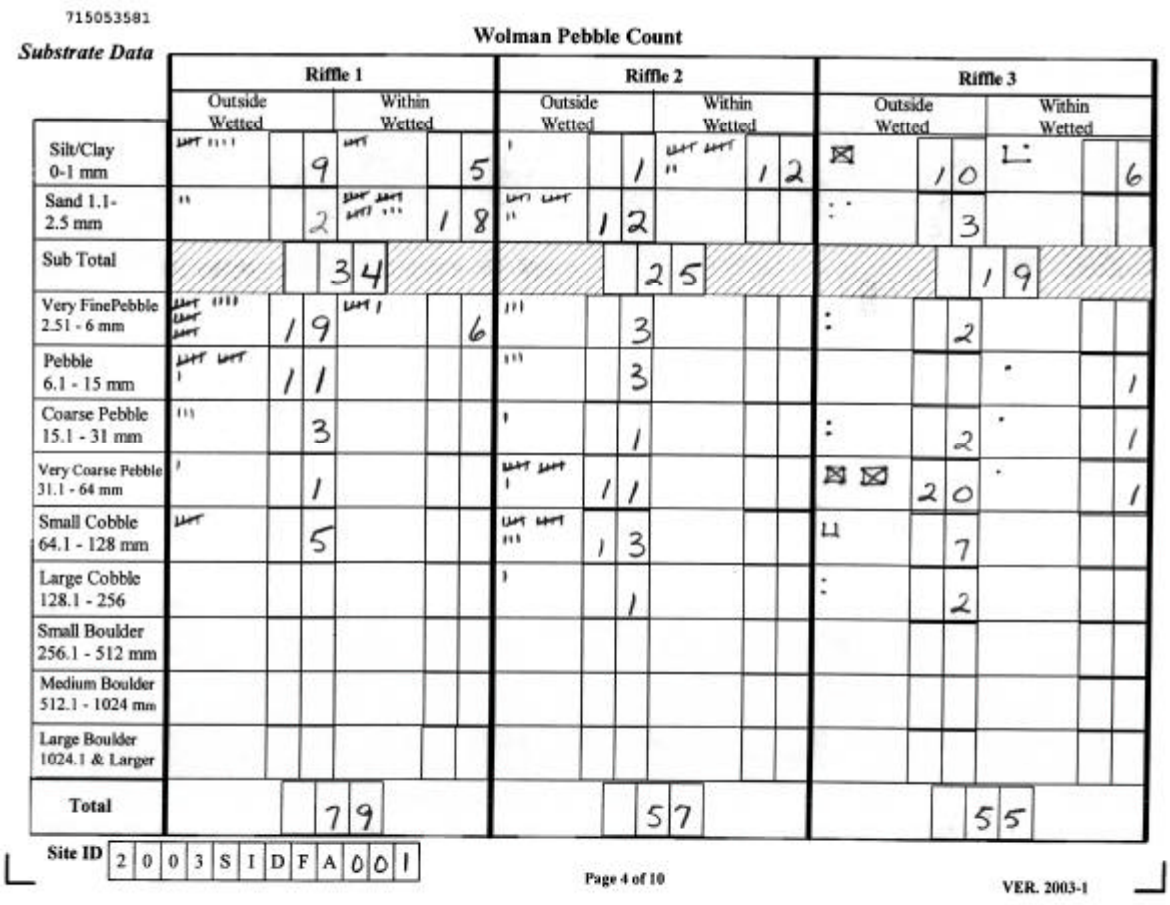


Figure 20. Substrate Data page example.

3.3.7.1 Pebble Count

The BURP process uses a modified Wolman Pebble Count (Wolman 1954) to quantify substrate size distribution in riffle habitats. This BURP pebble count method relies on surface fines, which are defined as material < 2.5 mm in diameter (Fore and Bollman 2002). These are used as a sediment metric in the Stream Habitat Index. Substrate is the mineral and organic material forming the bottom of a waterway or water body (Armantrout 1998). The stream substrate is the site of most biotic activity such as algae growth, insect growth and development, fish egg incubation, and small fish refuge (Davis et al 2001). Fine sediment and its accumulation can be detrimental to salmonid spawning (a beneficial use) since it may limit the quality and quantity of the inter-gravel spaces that are critical for egg incubation (Maret et al. 1993, Young et al. 1991, and Scrivener and Brownlee 1989). Several studies and state projects have found relative substrate size to be an important indicator of water quality effects due to activities in the watershed (Overton et al. 1993, McIntyre 1993b, Skille 1991).

Conduct pebble counts (substrate measurements) at the same three transects (T1, T2, and T3) in the riffle habitat units where macroinvertebrate and periphyton samples were collected. Work in undisturbed substrate above where those samples were collected, but within the riffle. If that is not possible, work within 1 meter below where the samples were collected, in undisturbed riffle substrate. Begin at the bankfull level on one streambank and proceed across the riffle to the bankfull level on the opposite streambank. Select pebbles at equidistant intervals (e.g., heel to toe, one pace, etc.). At each interval, reach to the stream bottom, pick up the first particle touched, and measure the intermediate axis. Record the particle size class and whether the particle was chosen from within or outside the wetted stream. Replace the particle downstream of the transect line. Disturb the bottom as little as possible. Measure a minimum of 50 particles per riffle for a total of 150 particles. Continue measuring and recording until the opposite streambank is reached, even if 50 pebbles have been counted before the transect is complete. Each successive pass must be upstream from the previous pass if multiple passes are required to reach the minimum 50 pebbles per riffle.

While counting, make tally marks (tick marks) in the appropriate tally area on the field form. Two different ways of making tally marks are shown on the example page in Figure 20: hash marks and dot-lines. When finished counting, add the tally marks and put the individual total for each field in the appropriate cell. The fields are right justified.

It is not necessary to fill in the fields labeled Subtotal (third line) and Total (last line), as the program will calculate these. However, you may fill them in if you want.

3.3.8 Width, Depth, Canopy, Banks Data Page

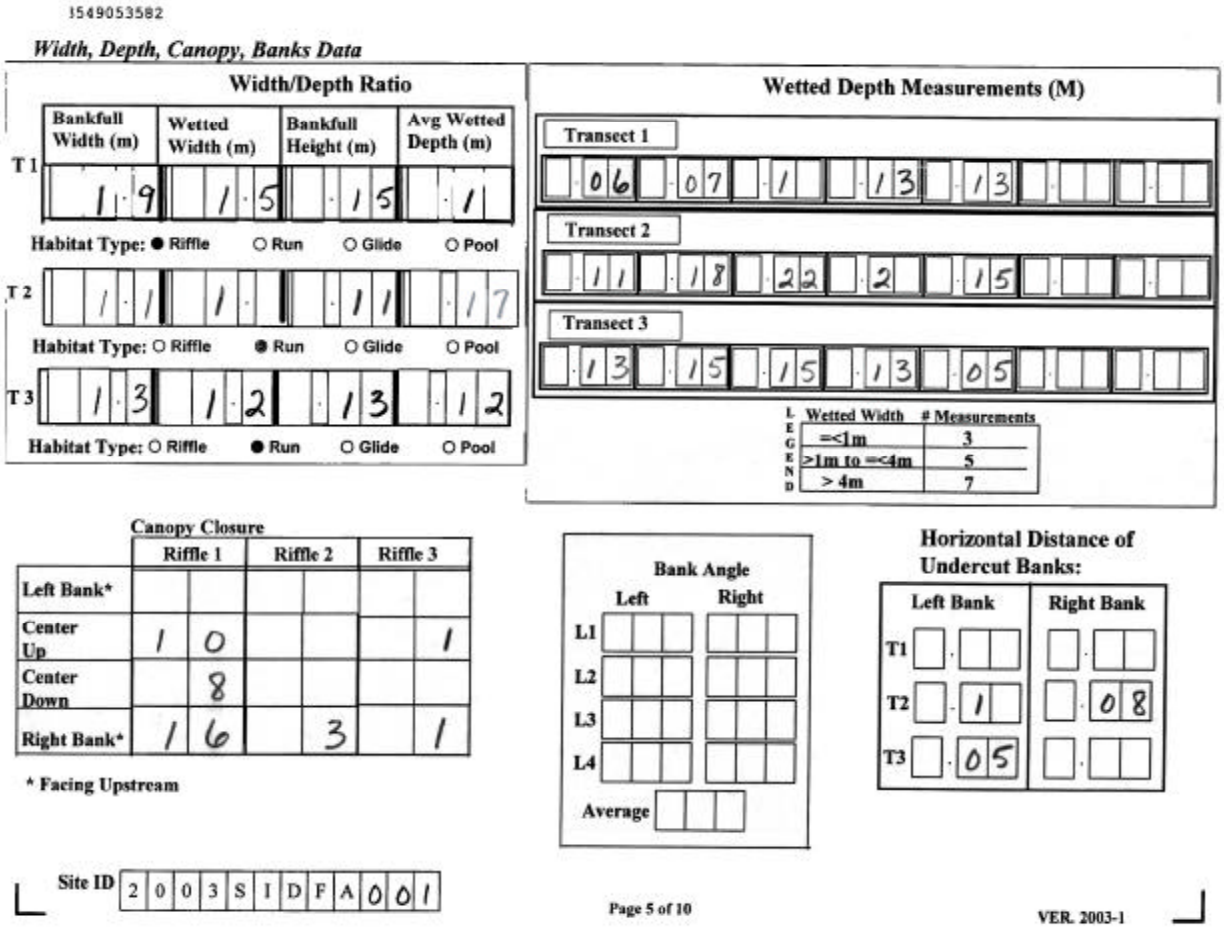


Figure 21. Width, Depth, Canopy, Banks Data page example.

3.3.8.1 Width/Depth Ratio

The width/depth ratio is defined as the ratio of the bankfull surface width to the mean depth of the bankfull channel (Rosgen 1996). DEQ also measures wetted width. The wetted width is the width of a water surface measured perpendicular to the direction of flow at a specific discharge. Widths of multiple channels are summed to represent the total wetted width.

The width/depth ratio is key to understanding the distribution of available energy within a channel and the ability of various discharges occurring within the channel to move sediment (Rosgen 1996). Rosgen (1996) also states that the width/depth ratio provides a rapid, visual assessment of channel stability. Further, the width/depth ratio is valuable in describing channel cross-section shape, and ratio values can be compared to interpret shifts in channel stability following disturbances to channels or watersheds (Rosgen 1996). Both depth and width can respond rapidly to changes in sediment load and/or discharge (Gordon et al. 1992, Overton et al. 1995). Width and depth measurements along with discharge data provide meaningful

information about stream size and habitat characteristics. These variables have significant impact on the distribution of the aquatic community. Further, grouping rivers by width and depth may be useful for data comparison purposes (Idaho Department of Health and Welfare 1996).

To collect width and depth measurements, first establish an additional transect 10 meters upstream from each riffle habitat unit transect (where macroinvertebrates and periphyton were collected). If necessary, take the third set of measurements outside the defined reach.

Conduct the procedure (detailed below) for measuring width and depth from the left bank to the right bank while facing upstream. Record width and depth measurements on the Width, Depth, Canopy, Banks Data page of the field forms. These are all decimal justified fields.

1. Measure bankfull width and height:

    - Stretch, secure, and level the tape across the bankfull width. Ensure the tape is perpendicular to the flow. Measure and record bankfull width.

    - Identify the bankfull stage, using, in part, Leopold et al. (1995).

    - Measure and record the bankfull height from the tape at bankfull elevation to the left wetted edge of the stream. Use the rating curve in Figure 22 to assist in identifying bankfull height. This rating curve is also illustrated in the DEQ flip charts.

2. Measure wetted width from the left to the right wetted edge of the stream.
3. Take wetted depth measurements:

    - Measure and record wetted depth measurements from the water surface to the channel bottom at evenly spaced intervals across the wetted width. Determine the number of intervals based on the wetted width of the stream. Use the following guideline to determine whether 3, 5, or 7 measurements are necessary (interval = wetted width divided by n+1):

Wetted Width	# Measurements (n)
$\leq$ 1 meter	3
> 1 but $\leq$ 4 meters	5
> 4 meters	7

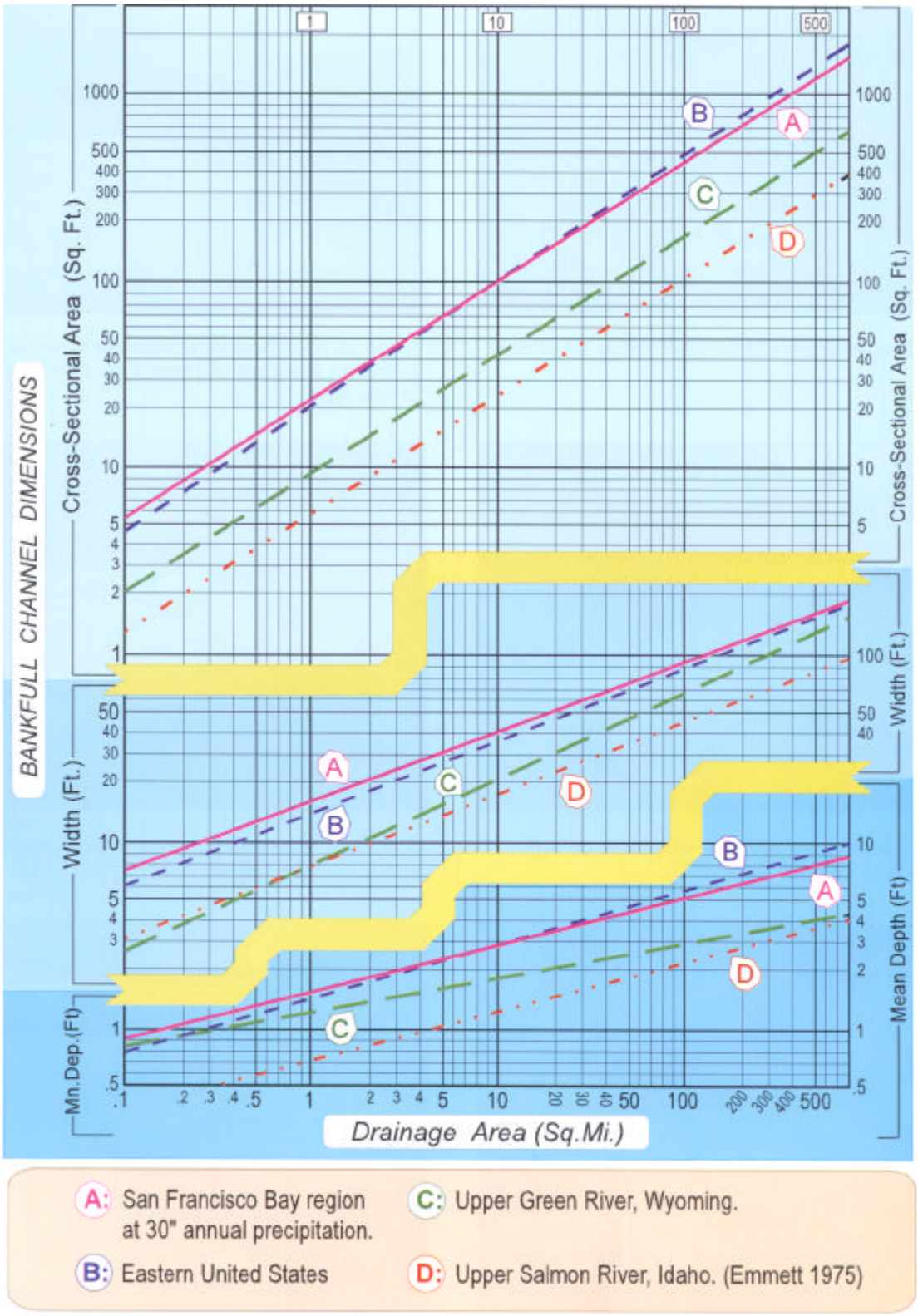


Figure 22. Rating curve to assist in identifying bankfull height.
(from Rosgen 1996, used with permission)

The program will calculate average wetted depth. If a zero depth is encountered, record the zero on the form. When a width/depth transect is in a split channel, use one of two methods:

- If the area between the channels is above the ordinary high water level, take measurements in the channel with the most discharge.

- If the area between the channels is below the ordinary high water level, take measurements across both of the channels and indicate that it is a split channel in the Comments section.

Record the habitat type. This is a mandatory, single selection field; choose only one for each transect.

3.3.8.2 Canopy Closure

anopy closure is the percentage of ground or water covered by shade from the outermost perimeter or natural spread of foliage from plants (Armantrout 1998).

Use a concave spherical densiometer to determine canopy cover. DEQ uses a densiometer modified with tape to show only 17 grid intersections (Bauer and Burton 1993). The 17 grid intersections are marked with dots in the illustration in Figure 23. Hold the densiometer level. You should just see the top of your head in the reflection (see Figure 23). Count the number of densiometer grid intersections obstructed by overhead vegetation. Take densiometer readings at all three riffle habitat unit transects (T1, T2, and T3, where the macroinvertebrate samples were taken). Take one to four readings per cross-section: right bank, left bank, stream center facing upstream, and stream center facing downstream. When moving to change from the stream center facing upstream to stream center facing downstream, make sure the densiometer remains in the same spot. Hold the densiometer one foot above the water surface for all measurements. When measuring at right and left wetted edges, face the bank and position the densiometer one foot in from the streambank and one foot above the water surface (Figure 24).

This is a right justified field, for numeric characters only.

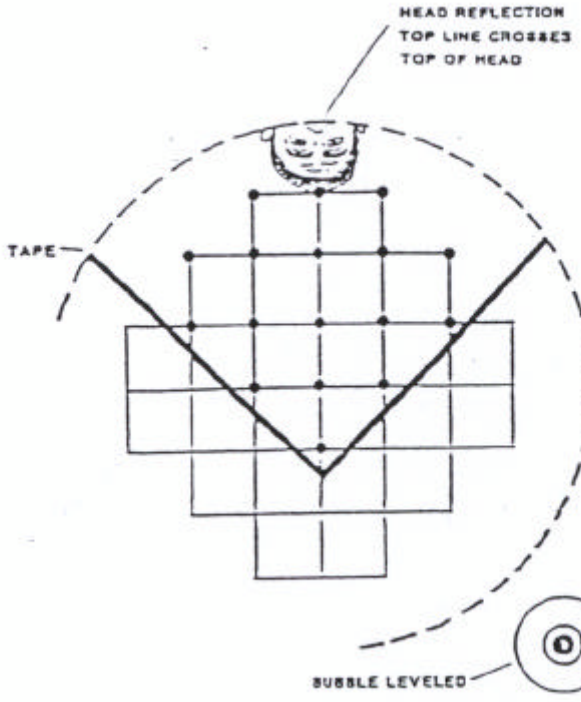


Figure 23. Reflection seen in densiometer.

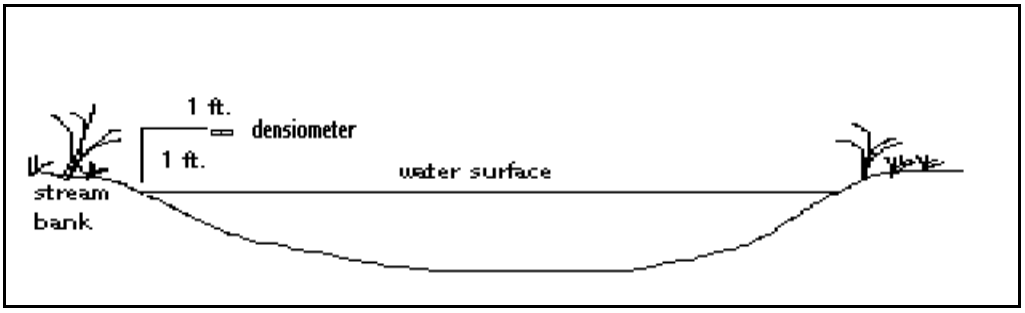


Figure 24. Position of densiometer.

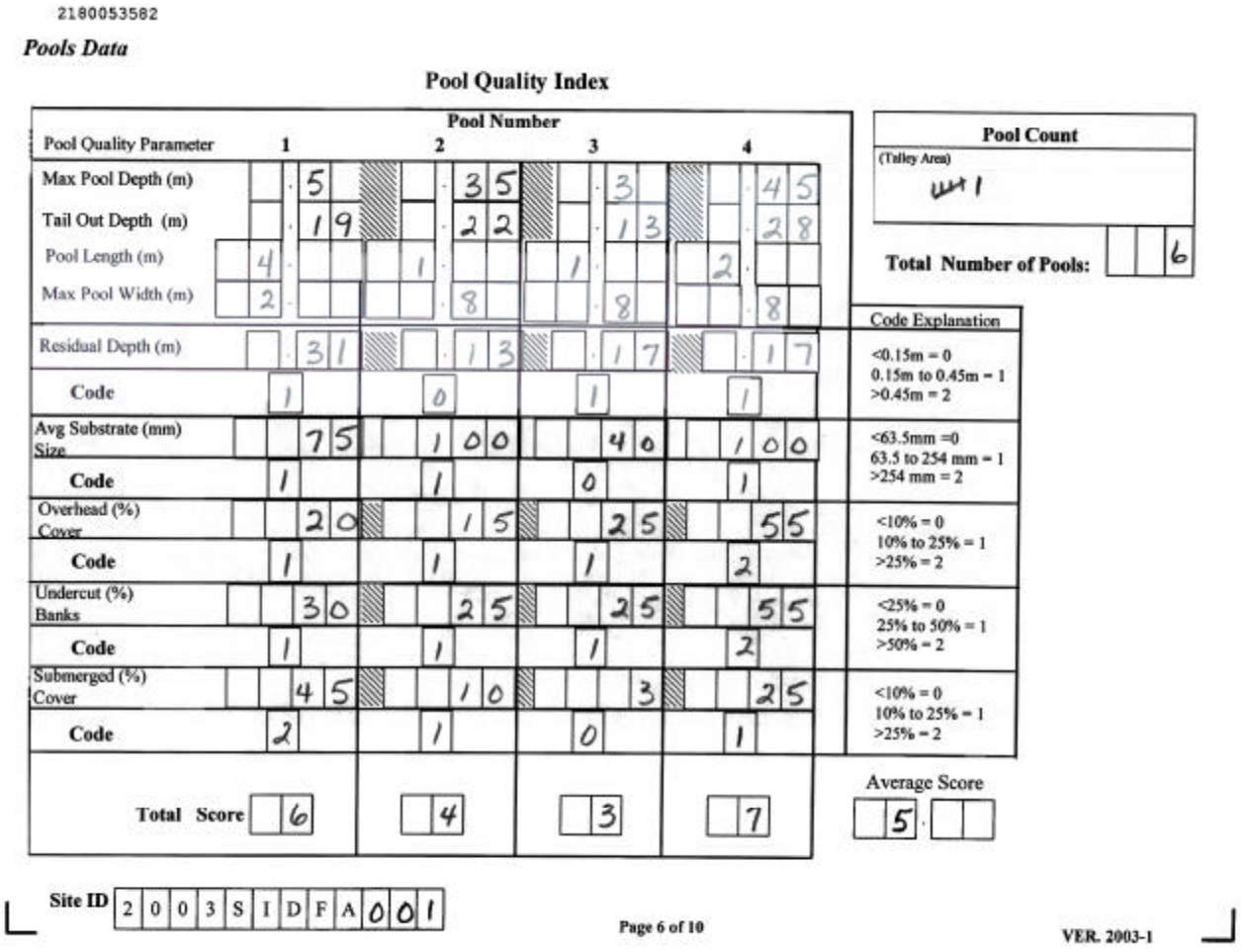
3.3.8.3 Bank Angle

Measure and record the bank angle. Bank Angle is not part of the BURP database; it is measured only to help with determination of Channel Shape, which is covered in section 3.3.10.3.3.5.

3.3.8.4 Horizontal Distance of Undercut Banks

Measuring the horizontal distance of undercut banks is discussed in section 3.3.10.3.1.5 and should be done when at the end of the tape when measuring width/depth.

3.3.9 Pools Data Page


2180053582

Pools Data

Pool Quality Index

Pool Quality Parameter	1	2	3	4
Max Pool Depth (m)	5	35	3	45
Tail Out Depth (m)	19	22	13	28
Pool Length (m)	4	1	1	2
Max Pool Width (m)	2	8	8	8
Residual Depth (m)	31	13	17	17
Code	1	0	1	1
Avg Substrate (mm) Size	75	100	40	100
Code	1	1	0	1
Overhead (%) Cover	20	15	25	55
Code	1	1	1	2
Undercut (%) Banks	30	25	25	55
Code	1	1	1	2
Submerged (%) Cover	45	10	3	25
Code	2	1	0	1
Total Score	6	4	3	7

Pool Count (Talley Area): 1

Total Number of Pools: 6

Code Explanation

<0.15m = 0
0.15m to 0.45m = 1
>0.45m = 2

<63.5mm =0
63.5 to 254 mm = 1
>254 mm = 2

<10% = 0
10% to 25% = 1
>25% = 2

<25% = 0
25% to 50% = 1
>50% = 2

<10% = 0
10% to 25% = 1
>25% = 2

Average Score: 5

Site ID: 2003SIDFA001

Page 6 of 10

VER. 2003-1

Figure 25. Pools Data page example.

3.3.9.1 Pool Quality Index

Pool quality refers to the diversity of habitats within a pool, which is largely a function of the amount of cover available in slow velocity waters (Bauer and Burton 1993). The Pool Quality Index (PQI) is a calculation that incorporates measures of pool length, substrate, overhead cover, submerged cover, percentage of undercut banks, maximum pool depth, maximum pool width, and depth at pool tailout.

In a study of streams that differed by the amount of management in their watersheds, Overton et al. (1993) found pools in less impacted watersheds were more frequent, had higher volumes, and were of greater depth than those in more impacted watersheds. Beschta and Platts (1986) suggested that pool quality is equally as important as the number of pools in describing a healthy stream from a fisheries standpoint. DEQ may calculate the pool to riffle ratio, a measure of pool

quantity, to evaluate and compare stream impacts. Figure 26 is a general illustration showing where some of the pool variables are measured**.**

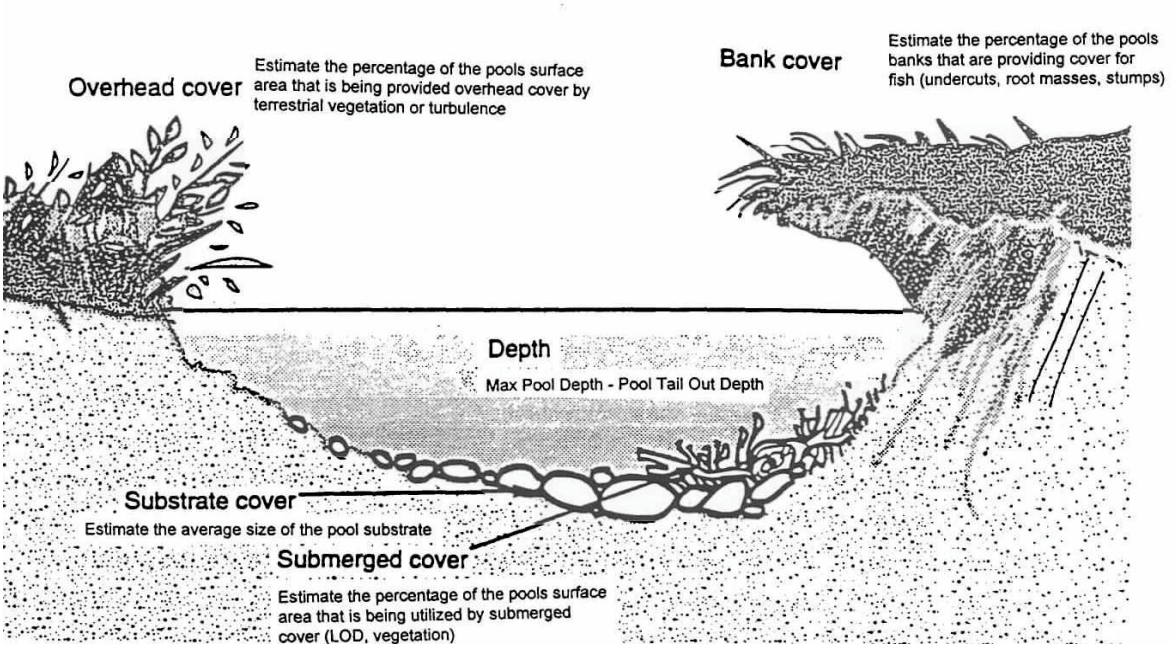


Figure 26. Where to measure some of the PQI variables at each pool.

If multiple pools are present, select four representative pools that characterize the variety of pool types found within the BURP reach, randomly distributed throughout the reach. If there are fewer than four pools in the reach, measure what exists and explain this in the Comments section of the field forms. Use pools that are less than 50% of the channel width for determining pool quality.

Measure the variables of maximum pool depth, tail out depth, pool length, maximum pool width, and undercut banks. Estimate the average (dominant) substrate size and the percentages for overhead cover and submerged cover. Calculate the residual pool depth. Each of these is described below. Enter all values in the appropriate field in the Pool Quality Index table. All of these field are decimal justified. Record the actual measurements. The program will fill in the codes. (For information, codes are given in the last column of the Pool Quality Index table.)

- Maximum Pool Depth (m) **–** The deepest point in the pool as measured from the water surface (Figure 27).

- Tail Out Depth (m) – The deepest point at which the water flows from the pool. This point is usually located along the downstream perimeter of the pool (Figure 27).

- Pool Length (m) – The distance from the upstream perimeter to the downstream perimeter of the pool (Figure 27).

- Maximum Pool Width (m) – The distance between the left and right perimeters of the pool when looking upstream (Figure 27).

Figure 27 shows where the depth, length, and width measurements are taken.

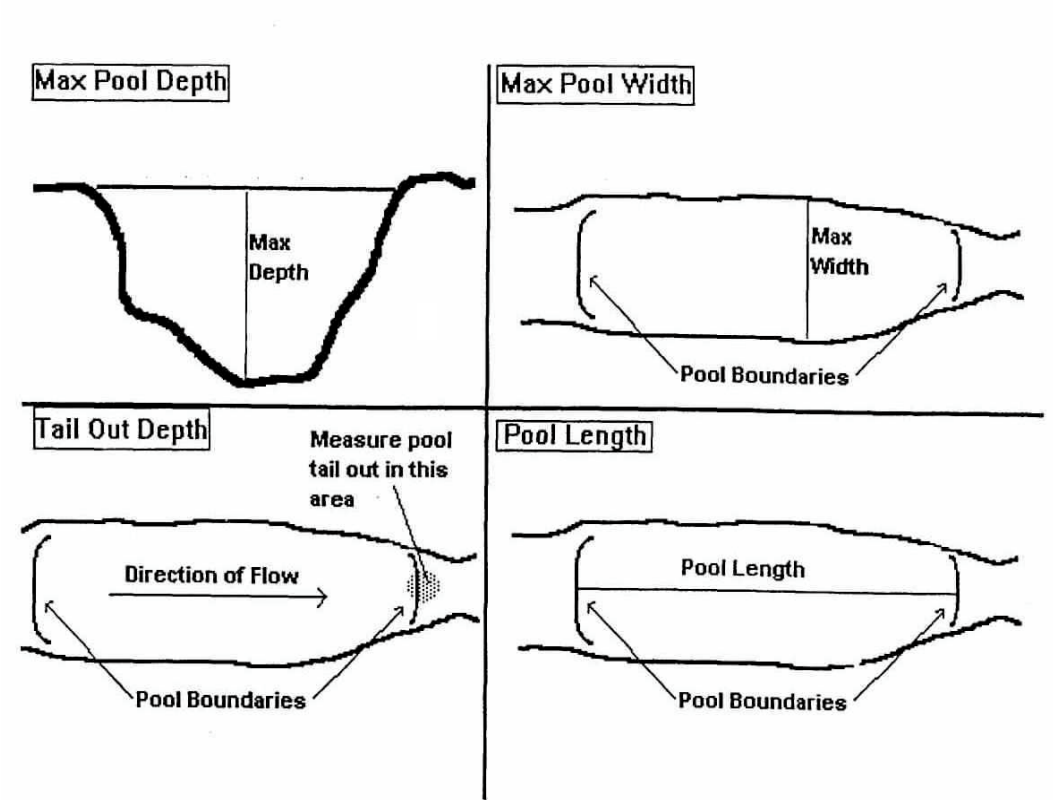


Figure 27. Where to measure pool depths (maximum and tail out), length, and width.

- Residual Depth (m) **–** The maximum depth of the pool under no-flow conditions. Calculate by subtracting tail out depth from maximum pool depth.

- Average Substrate Size (mm) – The size of the dominant substrate within the pool.

Overhead Cover (%) – Any cover within one foot (0.3 meters) of the pool surface, which tends to obscure the view of the pool surface. Overhanging banks and vegetation are typical examples; turbulence of sufficient magnitude to obscure the view into the water column is also considered overhead cover. Estimate this as percent of total pool surface area covered (See Figure 26).

- Undercut Banks (%) – The percent of undercut banks serving as cover along the pool's perimeter. Caution: One side of an evenly proportioned pool represents 50% of the possible total for undercut banks; some pools contact the bank on only one side (or less) of their perimeter.

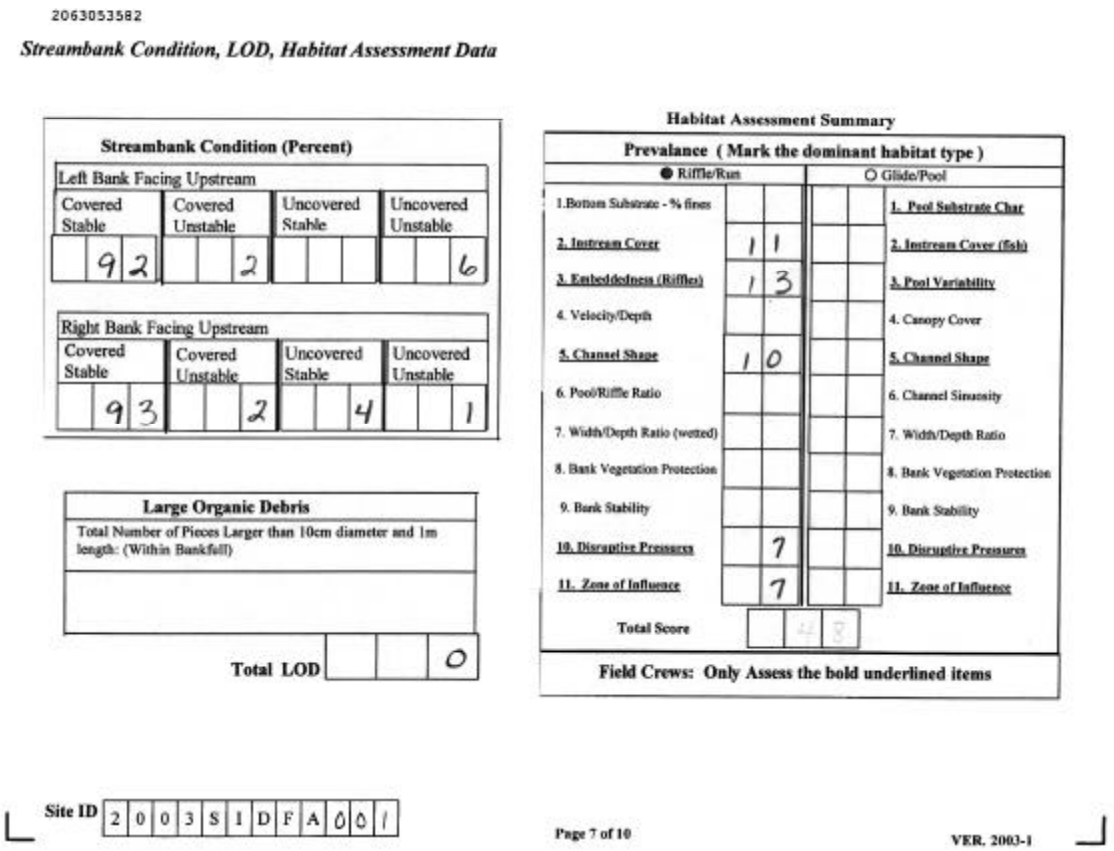
- Submerged Cover (%) – Under surface cover as represented by plants, woody debris, boulders, cobble, geologic morphology, or any relatively permanent structure that provides refuge for aquatic fauna. Estimate as a percent of the pool bottom area providing or under the influence of subsurface cover.

The program will calculate total scores for each pool and the average score for the reach.

3.3.9.2 Pool Count

Count all the pools in the reach. Make tally marks (tick marks or hash marks) in the Tally Area of the Pool Count box. Record the total number of pools. This is a right justified field.

3.3.10 Streambank Condition, Large Organic Debris, Habitat Assessment Data Page



2063053582

Streambank Condition, LOD, Habitat Assessment Data

Streambank Condition (Percent)

Left Bank Facing Upstream

Covered Stable	Covered Unstable	Uncovered Stable	Uncovered Unstable
92	2		6

Right Bank Facing Upstream

Covered Stable	Covered Unstable	Uncovered Stable	Uncovered Unstable
93	2	4	1

Large Organic Debris

Total Number of Pieces Larger than 10cm diameter and 1m length: (Within Bankfull)

Total LOD: 0

Habitat Assessment Summary

Prevalance (Mark the dominant habitat type)

	● Riffle/Run		○ Glide/Pool		
1.Bottom Substrate - % fines					1. Pool Substrate Char
2. Instream Cover	1	1			2. Instream Cover (fish)
3. Embeddedness (Riffles)	1	3			3. Pool Variability
4. Velocity/Depth					4. Canopy Cover
5. Channel Shape	1	0			5. Channel Shape
6. Pool/Riffle Ratio					6. Channel Sinuosity
7. Width/Depth Ratio (wetted)					7. Width/Depth Ratio
8. Bank Vegetation Protection					8. Bank Vegetation Protection
9. Bank Stability					9. Bank Stability
10. Disruptive Pressures		7			10. Disruptive Pressures
11. Zone of Influence		7			11. Zone of Influence
Total Score		4	3		

Field Crews: Only Assess the bold underlined items

Site ID: 2003S1DFA001

Page 7 of 10

VER. 2003-1

Figure 28. Streambank Condition, Large Organic Debris, Habitat Assessment Data page example.

3.3.10.1 Streambank Condition

The streambank is defined as that part of the channel most susceptible to erosion during high water events. Streambanks are important transition zones between aquatic and terrestrial systems (Stevenson and Mills 1999). When in good condition, these habitats are well vegetated, resistant to erosion, and provide cover and refuge for fish species. Banks stabilized by deeply rooted vegetation, rocks, logs, or other resistant materials are less susceptible to flow-related erosion, reduce water velocity along the stream perimeter, and aid in beneficial sedimentation (Bauer and Burton 1993). Human impacts and natural disturbances reduce bank vegetation, erosion resistance, structural stability, and fish cover value. Eroding streambanks support little or no riparian vegetation, resulting in a loss of stream shading, undercut banks, and nutrient loading, and a reduction in terrestrial insects dropping into the stream (important fish food source) (Overton et al. 1995). The removal of streambank vegetation and soils reduces the structural stability of the stream channel and negatively affects fish productivity (Platts 1990, Platts and Nelson 1989).

Bank cover refers to the percent surface protection (Stevenson and Mills 1999). It is generally viewed at the vegetative green line located below the bankfull level but above any natural undercutting bank scour.

Using a modified version of Burton (2002), the streambank is categorized as covered and stable, covered and unstable, uncovered and stable, or uncovered and unstable.
Determine the streambank condition on the left bank and the right bank (when facing upstream). Using a two-meter stick, a tape, or a laser rangefinder, measure the total number of meters of streambank that fall into each of the four categories. These values are used to calculate what percent of the reach is characterized by each of the four bank conditions.

Identify the streambank located between the scour line and the floodplain line. The bank is that portion of the channel margin above the scour line at the steepest angle to the water surface. View the scour line level along the entire length of the stream reach. The scour line can be located by examining features in the channel. For instance, the ceiling of undercut banks, the limit of sod forming vegetation, and the limit of perennial vegetation all clearly identify the scour line level. Evaluate streambank cover when water is at or below the scour line. If a vertical bank is greater than two meters high, examine only the first two meters. The floodplain line is the upper limit of the streambank. It is defined by that elevation where water first spills onto the lowest floodplain terrace. On gravel and sand bars, the bank is often defined by the limit of sod or perennial vegetation or by an indentation in the bar (local steepened area) just above the scour line. That small indentation or lip is the bank as defined in the procedure.

Evaluate streambank cover and stability according to the following descriptions.

3.3.10.1.1 Streambank Cover

Streambanks are considered covered if any of the following are true: (Burton 2002):

- Perennial vegetation ground cover is greater than 50%.
- Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover).
- At least 50% of the bank surfaces are protected by rocks of cobble size (150 mm) or larger.
- At least 50% of the bank surfaces are protected by logs with 10 centimeter (4 inch) or larger diameter.
- At least 50% of the bank surfaces are protected by a combination of the above.

3.3.10.1.2 Streambank Stability

Bank stability pertains to the resistance of a bank to erosion (Armantrout 1998). Banks are considered stable if they **do not show** indications of **any** of the following features (Burton 2002):

- Breakdown – obvious blocks of bank broken away and lying adjacent to the bank breakage.

- Slumping or false bank – the bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious.

- Fracture – a crack is visibly obvious on the bank indicating that the block of bank is about to slump or move into the stream.

- Vertical and eroding – the bank is mostly uncovered as defined above and the bank angle is steeper than 80 degrees from the horizontal.

3.3.10.1.3 Streambank Condition Categories

Classify each streambank into the following four condition categories. For each condition category, record a percentage with the total not exceeding 100% for each streambank (i.e., the left streambank equals 100% and the right streambank equals 100%, not 50 percent each). These are right justified fields.

- Covered and Stable (non-erosional) – Streambanks are covered and stable (according to Burton 2002, as defined above). Banks associated with gravel bars with perennial vegetation above the scour line are in this category.

- Covered and Unstable (vulnerable) – Streambanks are covered as defined above and not stable as defined above. These banks are typically observed in meadows where breakdown, slumping, and/or fracturing is present along the bank, yet vegetative cover is abundant.

- Uncovered and stable (vulnerable) – Streambanks are not covered as defined above and stable as defined above. Uncovered, stable banks are typical of streamsides trampled by concentrations of ungulates. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated.

- Uncovered and unstable (erosional and depositional) – Streambanks are not covered as defined above and not stable as defined above. These are bare, eroding streambanks and include all banks mostly uncovered that are at a steep angle to the water surface.

3.3.10.2 Large Organic Debris

In the Pacific Northwest, organic debris, such as a dead log or a tree, is considered LOD if it has a diameter greater than 10 centimeters (4 inches) and a length greater than one meter (39 inches) (Armantrout 1998, Davis et al. 2001). The term LOD is synonymous with large woody debris (LWD) described in other literature.

Large organic debris adds complexity to stream habitats, retains allochtonous matter and sediment, and imparts stability to streams under high flow conditions. Some species of salmonids show a high affinity for LOD (Rieman and McIntyre 1993). Further, LOD reduces the export of organic matter and nutrients and provides protection and habitat for invertebrates and fish (Davis et al. 2001). Experimental studies done by Braudrick and Grant (2000) have shown

that the two most important factors in the entrainment of LOD are the orientation of the LOD pieces and the presence/absence of rootwads.

Count each piece of LOD that is predominantly greater than 10 centimeters in diameter and 1 meter in length and is not alive. Count all LOD within the bankfull channel throughout the site. Occasionally, sites will be encountered with large accumulations of LOD. At these sites, it is acceptable to count up to 100 pieces then estimate thereafter. Specifically, if there are less than 100 pieces of LOD in the site, count them individually; if there are more than 100 pieces in the site, count by tens. When dealing with large amounts of LOD, each piece counted **must meet** the minimum size requirement, which are noted on the field form. If there is an accumulation of pieces that do not meet the minimum size requirement, take a photo of the pile and make note of it in the Comments section of the field forms. Count material naturally recruited from the drainage.

This is a right justified field.

3.3.10.3 Habitat Assessment Summary

Habitat is a specific type of place within an ecosystem occupied by an organism, population, or community that contains both living and nonliving components with specific biological, chemical, and physical characteristics including the basic life requirements of food, water, and cover or shelter. The habitat assessment is a combination of quantitative and qualitative measures of several habitat variables. Specifically, it is a modification of the habitat assessment method in the EPA Monitoring Handbook (Hayslip 1993). DEQ has modified the Hayslip 1993 approach to quantitatively calculate several of the variables. The variables used in the habitat assessment are sometimes different depending on the dominant habitat type (riffle/run versus glide/pool).

Physical habitat quality can significantly influence the biological condition of aquatic communities. Under contract to DEQ, Fore and Bollman (2000) developed a stream habitat index (SHI) as an analytical tool for assessing aquatic life beneficial uses for wadeable streams. Some of the BURP habitat assessment variables are components of the SHI.

The Habitat Assessment assesses the entire reach. The entire crew assesses habitat. At the end of the BURP survey, gather all the crew members and review the questions for the qualitative variables.

3.3.10.3.1 Designating Riffle/Run or Glide/Pool Prevalence

Determine if the stream is primarily riffle/run or glide/pool by looking at the data in the Longitudinal Habitat Distribution section of the field forms (see section 3.3.11.1). Choose the appropriate habitat assessment category (either riffle/run or glide/pool).

This is a mandatory, single selection field; choose only one.

3.3.10.3.2 Assessing the Qualitative Variables in the Habitat Assessment Summary

Refer to the appropriate DEQ laminated flip chart, also found in an appendix of this manual (Appendix F for riffle/run or Appendix G for glide/pool). As a group, discuss each of variables that are underlined on the field form and decide on a score for each. Evaluate the habitat for the present condition of the stream, without considering historical or future conditions. Record the scores in the appropriate cells in the Habitat Assessment Summary section on the right side of this page. All these fields are right justified.

3.3.10.3.3 Reaches With Riffle/Run Prevalence

3.3.10.3.3.1 Bottom Substrate - % fines

The proportion of fine sediments on the substrate surface of a stream can provide a good estimate of substrate habitat quality for salmonids. Excess fines can reduce embryo survival and impede emergence of fry (Bauer and Burton 1993).

Percent fines is a measurement of stream bed particles of 2.51 mm or less. The BURP process calculates percent fines from the pebble count. See section 3.3.7.1, Pebble Count, for further discussion.

3.3.10.3.3.2 Instream Cover Type

Instream cover consists of areas with structure (e.g., boulders, rocks, logs, etc.) in a stream channel that provide aquatic organisms with shelter or protection from predators or competitors. These are also places with low water velocity where organisms can rest and conserve energy (American Fisheries Society 1988). The availability of instream cover is important in sustaining a variety of fish throughout their life cycles. It provides refuge from predators, such as birds, terrestrial mammals, and other aquatic species. It also provides protection from sunlight and increased current velocities. (American Fisheries Society 1999).

Determine pool substrate composition and characteristics, then rate according to type and variety. A mix of substrate types including root masses, aquatic plants, and sands and gravels receive a higher score. Substrates with only one substrate type receive a lower score and those dominated by mud receive the lowest score. Rate the amount of instream cover based on the following types:

- Vegetation Cover –Vegetation that provides cover for protection of fish and other aquatic organisms, such as algal mats, macrophytes, and overhanging riparian vegetation. Cowley et al. (1992) is helpful in evaluating vegetation cover.

- Clump – Irregular accumulation of debris along a stream channel that does not form major impediments to stream flow.

- Log – In general, a tree trunk or large limb, with or without the roots attached.

- Substrate – The mineral or organic material forming the bottom of the water body. See section 3.3.7.1, Pebble Count, for further discussion.

- Large Organic Debris – Large woody material (e.g., log or tree) with a diameter greater than 10 centimeters (4 inches) and a length greater than 1 meter (39 inches).

- Turbulence – Stream flows in which the velocity at a given point varies erratically in magnitude and direction and disrupts reaches with laminar flow. Turbulence causes disturbance of the water surface and produces uneven surface levels which results in poor visibility and good protective cover because air bubbles are entrained in the water.

- Root Wad – Root mass from a tree. Synonymous with butt ends.

3.3.10.3.3.3 Embeddedness

Embeddedness is the degree to which very coarse pebbles and larger sizes of particles (cobbles and boulders) are surrounded or covered by fine sediment. For BURP monitoring, fine sediments are defined as 6.35 mm or less and larger particles are 45 mm to 300 mm (Burton and Harvey 1991). Fine sediment particles fill the small interstitial spaces between larger particles causing reduced water flow and a reduction of habitat that is important for the over wintering of small fish, some fish spawning, and sediment-intolerant macroinvertebrates (Bain 1999). See the pebble count section (3.3.7.1) for further discussion of substrate considerations.

This variable is primarily qualitative, since the quantitative methods provide little additional information for the purposes of beneficial use support and are very time consuming. To reduce the variability in qualitative assessments of embeddedness, DEQ provides centralized training to BURP crews on the ranges of embeddedness.

Determine the percentage of particles larger than very coarse pebbles that are surrounded or covered by sediment of 6.35 mm and less. Assign scores from 0 to 20 based on the percentage of embeddedness; bedrock is considered 100% embedded (score of 0). For streams with no embeddedness, the site will receive a score of 20. For every 5% increase in embeddedness, reduce the score one point (see Table 4).

Table 4. Embeddedness Scores Based on Embedded Percentage

% Embed-dedness	0	5	10	15	20	25	30	35	40	45
Score	20	19	18	17	16	15	14	13	12	11
% Embed-dedness	50	55	60	65	70	75	80	85	90	95
Score	10	9	8	7	6	5	4	3	2	1

3.3.10.3.3.4 Velocity/Depth

The velocity/depth ratio represents patterns of velocity and depth in a stream. The best streams in most high-gradient regions will have all four of these patterns present: slow-deep, slow-shallow, fast-deep, and fast-shallow (Barbour et al. 1999). This variable is calculated using the

presence and absence of different habitat types. To determine habitat types, refer to the Longitudinal Habitat Distribution section (3.3.11.1).

3.3.10.3.3.5 Channel Shape

Channel shape is the angle formed by the downward sloping streambank as it meets the horizontal water's edge. Fish often congregate near the streambank for the cover it provides. If the bank has been cut away and moved back from the water column, valuable rearing habitat has been lost. Measuring the channel bank angle is effective for monitoring land uses that can change the morphology and relative location of the streambank (Platts et al. 1987).

At a minimum of three locations along the reach, lay a straight edge of appropriate length against the left bank with one end at the water's edge. Lay the clinometer on the straight edge and read the bank angle in degrees from the external score on the clinometer (Peck et al. 1999). A vertical bank is 90 degrees. Undercut banks have angles greater than 90 degrees, approaching 180 degrees. Gradually sloping banks have angles less than 90 degrees. To measure bank angles greater than 90 degrees, turn the clinometer over and subtract the reading from 180 degrees. If the bank is undercut, measure the horizontal distance. Repeat this procedure for the right bank. Record the bank angles for left and right banks on the Width, Depth, Canopy, Banks data page and use the DEQ flip chart (Appendix F) to determine the appropriate score for the channel shape. The key is to include the midpoint of the dominant undercut in the bank profile.

3.3.10.3.3.6 Pool/Riffle Ratio

This is the ratio of the surface area or length of pools to the surface area or length of riffles in a given stream reach, expressed as the relative percentage of each category.
This ratio is used to predict the stream's capability of providing resting and feeding pools for fish and riffles to support their spawning and food production (Platts et al. 1983).
The total meters of pool present is divided by the total meters of riffle present. This variable is calculated using the Longitudinal Habitat Distribution data. See section 3.3.11.1 for further discussion.

3.3.10.3.3.7 Width/Depth Ratio (wetted)

This is the ratio of wetted water width to average water depth. This is a good indicator of channel cross-section shape.

Generally, deeper, narrower channels provide better habitat for various aquatic species. As streams become wider and shallower, they provide less habitat for organisms such as salmonids (Bauer and Burton 1993).

This variable is calculated using the width/depth ratio data. See the Width/Depth Ratio section (3.3.8.1) for further discussion.

3.3.10.3.3.8 Bank Vegetation Protection

This is a measure of the amount of vegetative protection afforded to the streambank and the near stream portion of the riparian zone.

The root systems of plants growing on streambanks help hold soil in place, thereby likely reducing the amount of erosion. This variable supplies information on the ability of the bank to

resist erosion as well as some additional information on the uptake of nutrients by the plants, the control of instream scouring, and stream shading (Barbour et al. 1999).

This variable is calculated using the Streambank Condition data. See the Streambank Condition section (3.3.10.1) for further discussion.

3.3.10.3.3.9 Bank Stability

This is a measurement of the stability of streambanks using vegetative cover and substrate cover.

Steep banks that don't have adequate cover are more likely to collapse and erode than gently sloping banks, and are therefore considered to be unstable. Stable, undercut banks provide better fish habitat than slumping, unstable banks. Stable banks contribute less sediment into the stream system than unstable, eroding banks (Barbour et al. 1999).

This variable is calculated using the Streambank Condition data. See the Streambank Condition section (3.3.10.1) for further discussion.

3.3.10.3.3.10 Disruptive Pressures

Disruptive pressure pertains to the anthropogenic impacts to the riparian zone. The measurement of disruptive pressures at each BURP site is a qualitative variable of the Habitat Assessment. This variable is used to determine seasonal human impacts on riparian zones. Seasonal impacts can include recreational activities (camping, hiking, fishing, hunting) and livestock grazing.

Rate disruptive pressures according to the descriptions provided on the DEQ flip charts (see Appendix F).

3.3.10.3.3.11 Zone of Influence

The zone of influence pertains to the width of the riparian vegetation zone. This area is directly affected by nearby ditches, channels, or other drainage features. The presence and condition of the riparian vegetation is important to the overall ecological health of the river and its floodplain. Healthy stands of riparian vegetation provide habitat for aquatic and terrestrial animals and perform important physical functions (e.g., erosion control, sediment catchment). Stands of naturally occurring riparian vegetation can vary from river to river depending on climate and geomorphology.

The zone of influence is used to determine the overall human impacts on a riparian zone such as roads, logging, lawns, campgrounds, and urban areas. Rate the zone of influence (the width of the riparian vegetative zone) based on the least buffered side. Use descriptions provided in the DEQ laminated flip charts (Appendix F) to select an appropriate rating. Due to geology, climate, vegetation, flow regimes, and other natural conditions, sometimes the zone of influence is naturally very narrow (less than one stream width). Examples of this are the deep, V-shaped valleys found in north central Idaho. Do not try to adjust ratings for natural conditions, (e.g., geology, climate, vegetation, flow-regime) as the DEQ classification system already considers these factors.

3.3.10.3.4 Reaches With Glide/Pool Prevalence

3.3.10.3.4.1 Pool Substrate Characteristic

Firm sediment types (e.g., gravel, sand) and rooted aquatic plants support a wider variety of organisms than a pool substrate dominated by mud or bedrock and no plants. In addition, a stream that has a uniform substrate in its pools will support far fewer types of organisms than a stream that has a variety of substrate types (Barbour et al. 1999). This variable is a visual estimate of the substrate materials that make up the pool (Hayslip 1993).

3.3.10.3.4.2 Instream Cover

See the discussion of Instream Cover under Riffle/Run Prevalence above, section 3.3.10.3.1.2.

3.3.10.3.4.3 Pool Variability

A pool is a portion of the stream with reduced water velocity and water deeper than the surrounding areas. The bottom of a pool is often concave, forming a depression in the profile of the stream's thalweg that retains water if there is no flow. The four basic types of pools are large-shallow, large-deep, small-shallow, and small-deep. A stream with many pool types will support a wide variety of aquatic species. According to Hayslip (1993), the greater the pool type diversity, the better the habitat. Conversely, streams with low sinuosity (few bends) and monotonous pool characteristics do not have sufficient quantities and types of habitat to support a diverse aquatic community.

Determine the proportion of large and small pools and the proportion of shallow and deep pools in general. In general, if any pool dimension (i.e., length, width, oblique) is greater than half the cross-section on the stream the pool is large. Give a high score if the stream is dominated by an even mix of all four sizes of pools. Give a lower score if the stream is dominated by large deep pools. Give an even lower score if the stream is dominated by shallow pools. Give the lowest score if the stream is dominated by small shallow pools or has no pools. In general a one-meter depth separates shallow and deep pools (Barbour et al. 1999).

3.3.10.3.4.4 Canopy Closure

Canopy closure is the area of the sky over the stream channel covered by vegetation. The amount of sunlight entering a stream determines, to a large extent, the rate of water warming. Well canopied streams have less water temperature fluctuation and provide better protected habitat for aquatic species (Bauer and Burton 1993).
This variable is calculated using the densiometer data. See the Canopy Closure section (3.3.8.2) for further discussion.

3.3.10.3.4.5 Channel Shape

See the discussion of Channel Shape under Riffle/Run Prevalence above (section 3.3.10.3.3.5).

3.3.10.3.4.6 Channel Sinuosity

This is a measurement of the meandering or sinuosity of the stream. A high degree of sinuosity provides for diverse habitat and fauna, and the stream is better able to handle surges when it fluctuates as a result of storms (Barbour et al. 1999). This variable is calculated using the sinuosity data. See the Sinuosity section (3.3.5.7) for further discussion.

3.3.10.3.4.7 Width/Depth Ratio

See the discussion of Width/Depth Ratio under Riffle/Run Prevalence above, section 3.3.10.3.3.7.

3.3.10.3.4.8 Bank Vegetation Protection

See the discussion of Bank Vegetation Protection under Riffle/Run Prevalence above, section 3.3.10.3.3.8.

3.3.10.3.4.9 Bank Stability

See the discussion of Bank Stability under Riffle/Run Prevalence above, section 3.3.10.3.3.9.

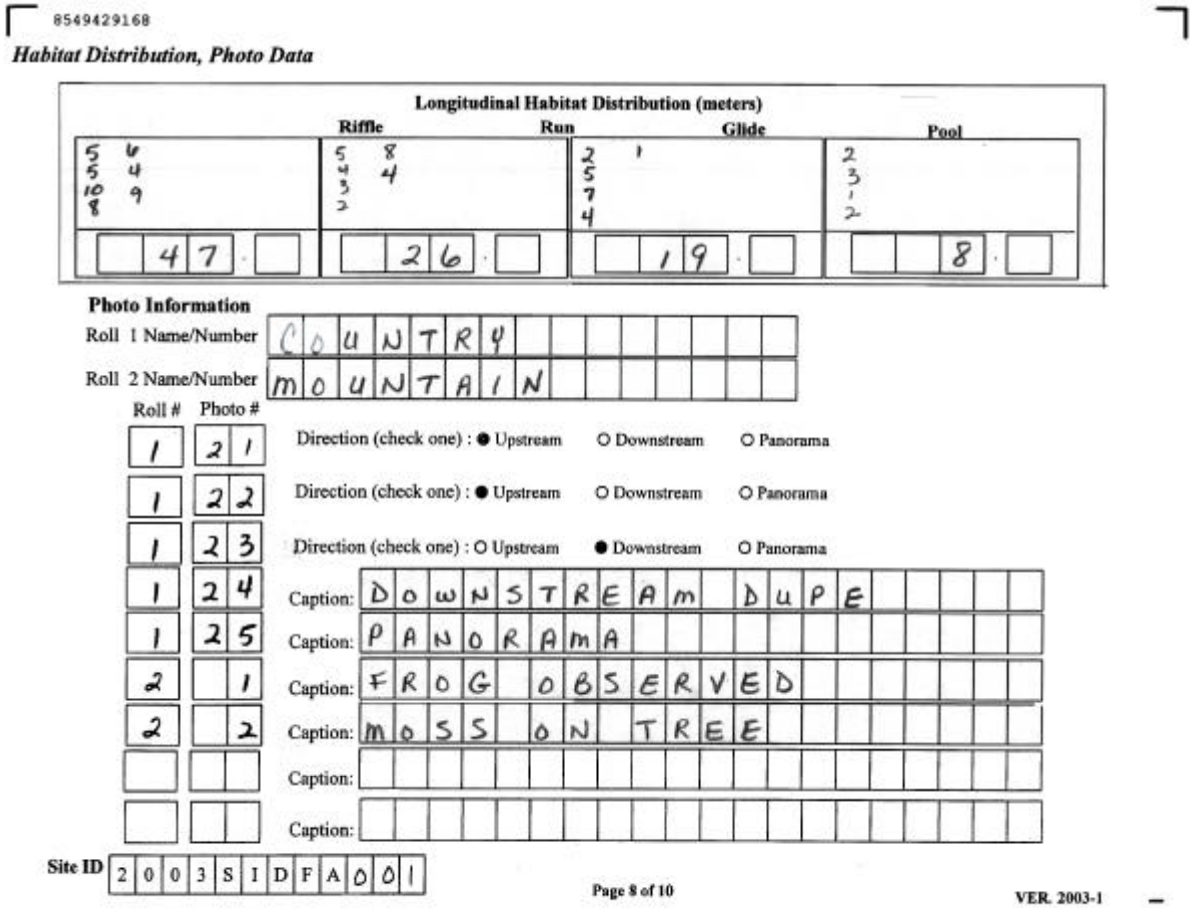
3.3.10.3.4.10 Disruptive Pressure

See the discussion of Disruptive Pressure under Riffle/Run Prevalence above, section 3.3.10.3.3.10.

3.3.10.3.4.11 Zone of Influence

See the discussion of Zone of Influence under Riffle/Run Prevalence above, section 3.3.10.3.3.11.

3.3.11 Habitat Distribution and Photo Data Page


8549429168

Habitat Distribution, Photo Data

Longitudinal Habitat Distribution (meters)

Riffle	Run	Glide	Pool
5 6 5 4 10 9 8	5 8 4 4 3 2	2 1 5 7 4	2 3 1 2
47.	26.	19.	8.

Photo Information

Roll 1 Name/Number: COUNTRY

Roll 2 Name/Number: MOUNTAIN

Roll #	Photo #		
1	21	Direction (check one) : ● Upstream	○ Downstream ○ Panorama
1	22	Direction (check one) : ● Upstream	○ Downstream ○ Panorama
1	23	Direction (check one) : ○ Upstream	● Downstream ○ Panorama
1	24	Caption:	DOWNSTREAM DUPE
1	25	Caption:	PANORAMA
2	1	Caption:	FROG OBSERVED
2	2	Caption:	MOSS ON TREE
		Caption:	
		Caption:	

Site ID: 2003SIDFA001

Page 8 of 10

VER. 2003-1

Figure 29. Habitat Distribution and Photo Data page example.

3.3.11.1 Longitudinal Habitat Distribution

The longitudinal habitat distribution is defined as the proportions of the channel represented by relatively homogeneous areas whose depth, velocity, and substrate characteristics differ from adjoining areas (Armantrout 1998).

DEQ identifies these main habitat types in the stream channel:

Riffle and Run Habitats – Areas of the stream with fast current and shallower depth; typically much of the water surface is visibly broken. Look for in Rosgen A type channels and higher gradient streams with coarser substrate. Can have numerous pools.

Pool and Glide Habitats – Usually few riffles and slower water column velocity. Generally but not always deeper than riffle-run streams. Number of pools can vary. Look for in lower gradient stream segments, often seen in wide, flat valleys. Usually more depositional in character.

Following are the descriptions used by BURP to distinguish these types of habitat.

Pool – A portion of the stream with reduced water velocity, water deeper than the surrounding areas, and the bottom often concave in shape forming a depression in the profile of the stream's thalweg that would retain water if there were no flow. Pools usually occur at outside bends (e.g., lateral scour) and around large obstructions (e.g., plunge pool). Pocket water pools refer to groups of small pools often in areas of otherwise fast or turbulent flow, usually caused by eddies behind boulders or other obstructions. Eddies are also associated with backwater pools. Water impounded upstream from channel blockage, typically caused by a log jam or beaver dam, is classed as a dammed pool. Flats are actually wide shallow pools often confused with glides. Pools end where the stream bottom approaches the water surface, also known as the pool tailout.

Glide – An area of the stream with slower current velocity and depth greater than riffles; the stream bed can be concave or flat and the channel width is frequently the greatest. The water surface gradient is nearly zero and the substrate tends to be finer than in runs. Is common to most modified stream channels that do not have distinguishable pool, run, and riffle habitats; current and flow are similar to that of a canal with smooth, laminar flow.

Riffle – A portion of the stream with swiftly flowing, shallow water with a turbulent water surface. The turbulence is caused by completely or partially submerged obstructions, often the stream bottom. Cascades are one class of riffle characterized by swift current, exposed rocks and boulders, and considerable turbulence, and consisting of stepped drops over steep slopes. Riffles that are swift, relatively deep, and have considerable surface turbulence, sometimes represented by standing waves, are called rapids. Rapids at high flow may be confused with runs.

Run – Areas of the stream that have swift, uniform, nonturbulent flow; runs are deeper than riffles with a faster current velocity than pools and (typically) glides; the stream bed can be flat beneath a run and the water surface is seldom broken. Surface gradient tends to roughly parallel overall stream gradient and substrate particle size can vary but tends to be coarser than in glides.

An evaluation of habitat diversity is critical to any assessment of ecological integrity. Water velocity, in conjunction with depth, has been demonstrated to have a direct influence on the structure of benthic communities (Osborne and Hendricks 1983; as cited in Plafkin et al. 1989) and fish communities (Oswood and Barber 1982).

Chapman (1966) stated that physical habitat regulates fish abundance. Researchers have correlated various components of physical habitat with fish abundance and denoted habitat type as an important factor (Hunt 1969, Graham et al. 1980, Fraley et al. 1981, Shepard et al. 1982, Shepard 1983, Pratt 1984, Irving 1987, Hoelscher and Bjornn 1989, Moore and Gregory 1989). Gorman and Karr (1978) took this relation one step further and found fish diversity, as well as abundance, increased with habitat diversity.

The classification of habitat units is geomorphic and flow dependent and may change with a change in discharge. Form a mental image of the various habitat types that should persist given the current conditions, then determine the type of habitat units present along the longitudinal stream axis. Assign wetted portions of the main channel to one of the four habitat types. Complexes of multiple habitat units may be encountered. In these cases measure and record the habitat type **occupying more than 50%** of the wetted channel width. Minor habitat units should be combined with adjacent units.

3.3.11.2 Photo Information

Photographic records provide visual details concerning riparian conditions and stream geomorphology. This visual information shows important stream characteristics such as land use, geomorphic channel units, habitat features, and bank conditions (Meador et al. 1993). Such visual details complement field notes and habitat measurements. This type of documentation may also provide baseline information concerning qualitative changes of riparian conditions and land use and stream channel modifications.

Take photographs at each reach to document its present condition. Each crew should have a compass and either slide film and a date-back camera or a digital camera. If slide film is used, take a minimum of four photos of the stream site from the center of the reach bottom, two facing upstream and two facing downstream (duplicate photos).

Photos are extremely valuable to individuals reviewing or assessing the data. Therefore, be sure to photograph anything unusual, beneficial uses, pollution sources, etc. Consider taking photos at the upper end of the reach as well. A panoramic view of the stream, riparian vegetation, and floodplain is also very helpful. Using a small hand-held location sign such as a dry erase board or chalk board is optional.

3.3.11.2.1 Roll Name

These are left justified fields, for alpha or numeric characters.

3.3.11.2.2 Roll Number and Photo Number

These are right justified fields (single digit for roll number) for numeric characters.

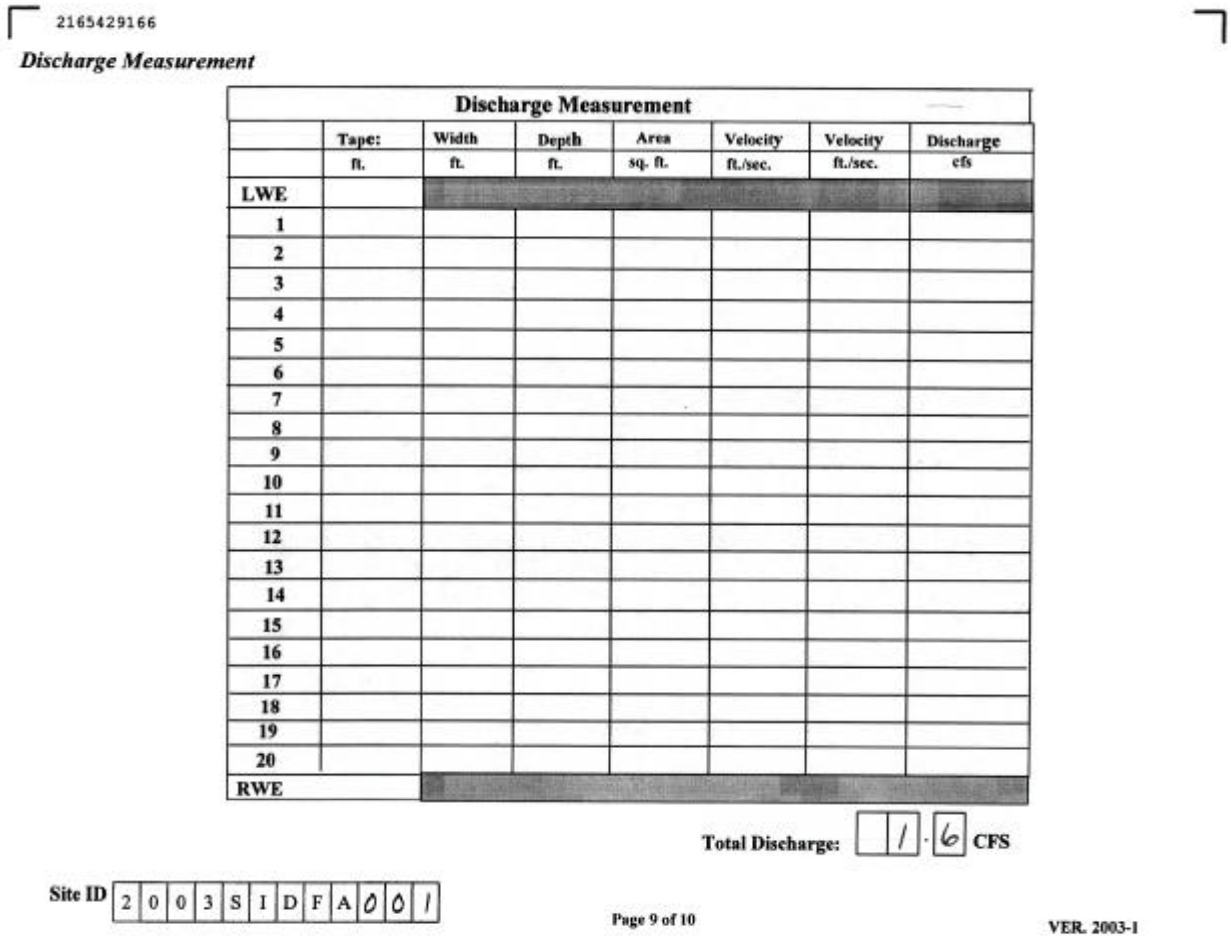
3.3.11.2.3 Direction

Generally, take the upstream photos first. In any event, indicate the direction for each of the first three photos. These are single selection fields; choose only one in each field.

3.3.11.2.4 Caption

These are left justified memo fields.

3.3.12 Discharge Measurement Page



2165429166

Discharge Measurement

Discharge Measurement

	Tape: ft.	Width ft.	Depth ft.	Area sq. ft.	Velocity ft./sec.	Velocity ft./sec.	Discharge cfs
LWE							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
RWE							

Total Discharge: 1.6 CFS

Site ID 2003SIDFA001

Page 9 of 10

VER. 2003-1

Figure 30. Discharge Measurement page example.

Discharge is the volume of water passing a given point per unit of time (Armantrout 1998). Davis et al. (2001) note that "discharge, at summer base flow, is a measure of minimum stream size and an indicator of potential habitat for fish and aquatic invertebrates." Nelson et al. (1992) found flow to be one of the physical attributes that distinguished streams from different geologic regions. Flow patterns affect habitat characteristics such as erosion (in part), distribution of aquatic assemblages, and movement of suspended materials (Rankin 1995). Other associated variables such as discharge and gradient may provide useful forms of stratification (Rankin 1995).

If using a pressure-sensitive electromagnetic flow meter (e.g., Marsh-McBirney Flowmate 2000), use the time-averaging function and set it for 10 second intervals. Record negative (-) readings of a pressure sensitive electromagnetic flow meter as 0. Locate a straight non-braided stretch of the sampling reach. Place a measuring tape across the stream perpendicular to the flow. Take evenly spaced velocity measurements (a minimum of 0.5 feet per measurement in the center of

the cell; see Figure 31) with 20 measurements from wetted bank to wetted bank so that no more than 5% of the total discharge is in each partial cross-section or cell (Harrelson et al. 1994). Record the horizontal distance measured from the tape. Record depth and velocity from the top-setting wading rod and electromagnetic velocity meter. If the stream is narrow with homogenous depth and substrate, more than 10% of the total discharge may be in any partial cross-section or cell. For depths less than 2.5 feet, take one velocity measurement at 60% of the depth. For depths greater than 2.5 feet, take two velocity measurements for each partial cross-section; one at 20% of the total depth and a second at 80% of the total depth. You may measure flow outside the reach if no suitable area is available within the reach; however, it should be taken no more than one reach length outside the survey reach and only where no other obvious inflow is taking place between the reach and the point chosen for measuring flow.
Total Discharge is a decimal justified field.
The entire stream width must be waded, so be particularly aware of personal safety while conducting flow measurements. If wearing waders, be sure the soles have adequate traction. If the stream cannot be safely waded, the river protocol should be used.

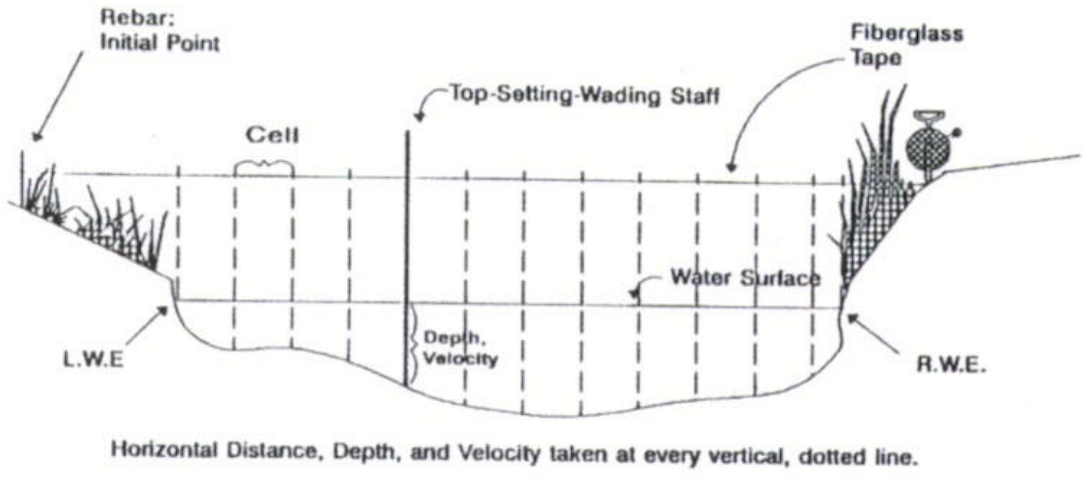
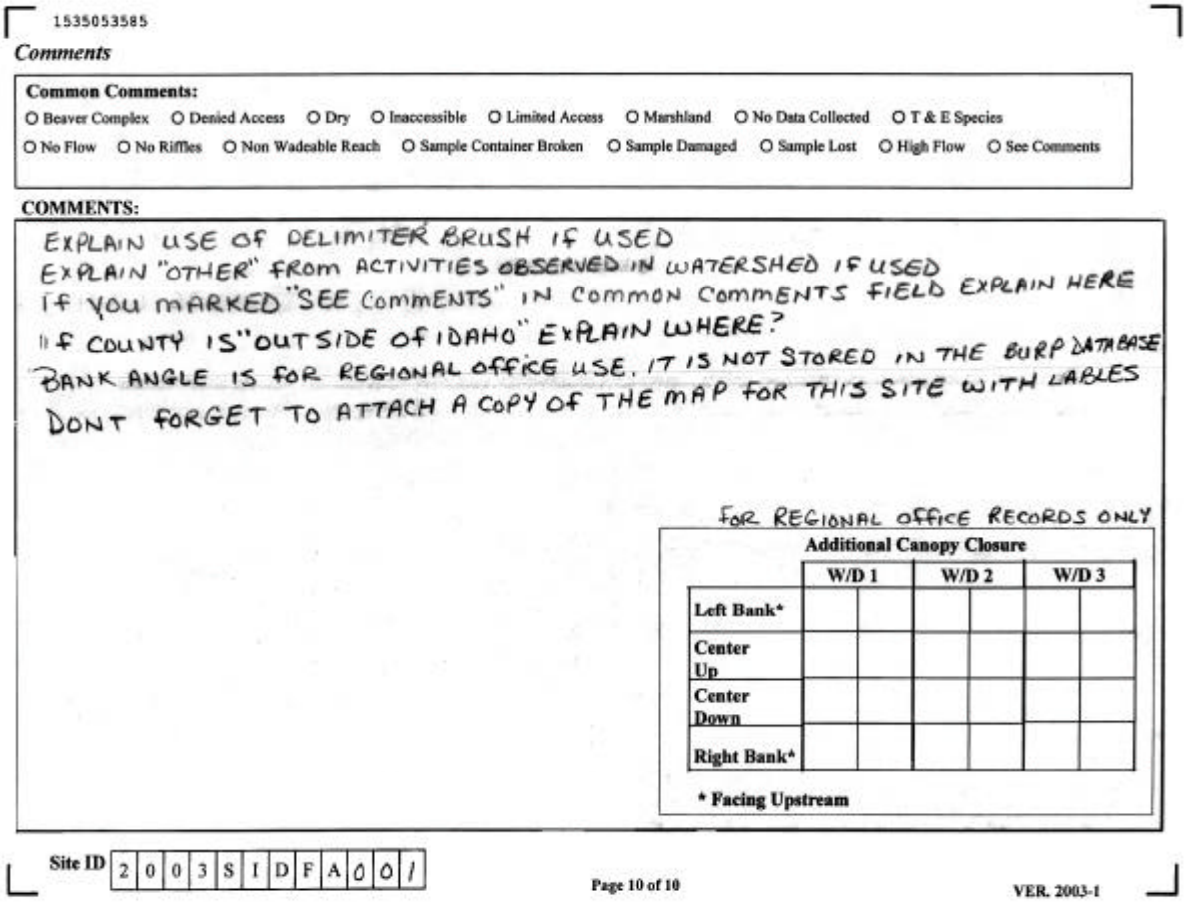


Figure 31. Illustration of Discharge Measurement Locations.

3.3.13 Comments Page



1535053585

Comments

Common Comments:

O Beaver Complex O Denied Access O Dry O Inaccessible O Limited Access O Marshland O No Data Collected O T & E Species
O No Flow O No Riffles O Non Wadeable Reach O Sample Container Broken O Sample Damaged O Sample Lost O High Flow O See Comments

COMMENTS:

EXPLAIN USE OF DELIMITER BRUSH IF USED
EXPLAIN "OTHER" FROM ACTIVITIES OBSERVED IN WATERSHED IF USED
IF YOU MARKED "SEE COMMENTS" IN COMMON COMMENTS FIELD EXPLAIN HERE
IF COUNTY IS "OUTSIDE OF IDAHO" EXPLAIN WHERE?
BANK ANGLE IS FOR REGIONAL OFFICE USE. IT IS NOT STORED IN THE BURP DATABASE
DONT FORGET TO ATTACH A COPY OF THE MAP FOR THIS SITE WITH LABLES

FOR REGIONAL OFFICE RECORDS ONLY

Additional Canopy Closure

	W/D 1		W/D 2		W/D 3	
Left Bank*						
Center Up						
Center Down						
Right Bank*						

* Facing Upstream

Site ID 2 0 0 3 S I D F A 0 0 1

Page 10 of 10

VER. 2003-1

Figure 32. Comments page example.

There are two sections on the Comments page. In the first section (Common Comments), select conditions or events they appear or occur in the reach. Write down any additional comments in the second section.

3.3.13.1 Common Comments

Fill in the circle for any of these conditions that exist or events that occur. This is a multiple selection field; choose all that apply.

3.3.13.2 Comments

Record any valuable information that is not called for elsewhere in the field forms such as observations concerning vegetation, geomorphology, impacts due to humans or natural events, riparian zone, fish, amphibians, etc. Also provide any needed explanations, such as information about collecting specimens (modification to protocol to collect samples) or factors affecting reliable data collection (high flow, low flow, etc.).
These comments are not "read" or stored directly by the database program; they are entered (typed in) separately by a data entry person. Please print legibly. The forms are kept on file for later reference.

3.3.13.3 Additional Canopy Closure

Fill in the Additional Canopy Closure section. This information is for regional office use only. It is not read or stored by the database program

3.3.14 Fish Data Sheets

3.3.14.1 Importance of Fish Data

Fish contribute significantly to the ecology of the aquatic community. This biological assemblage is highly visible to the public and is an important economic resource in Idaho. Additionally, fish have relatively long life spans which can reflect long term and current water quality conditions. Due to their mobility, fish also have extensive ranges and may be useful for evaluating regional and large habitat differences (Simon and Lyons 1995).

Each BURP site should have accompanying fish data that are less than five years old. BURP coordinators should look for other agency, index-compliant data, particularly if there are endangered species present that are not permitted for "take." It is recommended that the site be electrofished because comprehensive data with all species (game and non-game) and length is often not available elsewhere.

3.3.14.2 Permits for Taking Fish

Before performing any electrofishing, DEQ obtains all necessary permits. A Scientific Research and Take authorization must be obtained from the National Marine Fisheries Service in regions where steelhead and salmon occur. The permit is for researchers whose studies may capture, harass, or harm any species of fish. DEQ submits one statewide application directly with the National Marine Fisheries Service as 4(d) Scientific Research and Take Authorization. DEQ prepares a comprehensive report to meet steelhead permit reporting requirements.

Each DEQ regional office is responsible for coordinating and obtaining a Scientific Collection Permit from the IDFG. Each office adheres to the stipulations and provisions of the permit, particularly concerning waters containing endangered species. Often, permits include a stipulation that DEQ must "NOTIFY THE REGIONAL FISHERY MANAGER WITH A COMPLETE LIST OF DATES AND SAMPLE SITES PRIOR TO FIELD WORK." It is recognized this list may change. It is the responsibility of each DEQ regional office to update and provide IDFG with the most current information. It is the responsibility of each regional office to report to IDFG as required by the permit stipulation(s). It is also the responsibility of each DEQ office to discuss the stream list with the appropriate IDFG representative to identify streams known or likely to contain endangered species. Additionally, any concerns, requirements, and/or restrictions (i.e., spawning fish) need to be identified by the IDFG representative, documented, and communicated to the appropriate DEQ field crew, who must adhere to them.

Crew members need to completely read, understand, and adhere to the collection permit requirements. Usually the permit stipulates that a copy of the fish collection permit be kept with the crew in the field during electrofishing.

Idaho Department of Environmental Quality Fish Data Sheet

Location Information

Water Body Name _____ BURP Site Id _____

Location Description

_____

_____

Pass Information Pass ___ of ___

Collectors _____ Field Taxonomist _____

Date _____ Clarity _____ E-Fish Length _____

Avg Width _____ Water Temp (°C) _____ Conductivity _____

Electrofisher Model _____ Setting _____

Effort (seconds) _____ Voltage _____

Fish Collected

	Type	Length	Weight	Tag	Group	DEQ Code	Flag		Type	Length	Weight	Tag	Group	DEQ Code	Flag
1								22							
2								23							
3								24							
4								25							
5								26							
6								27							
7								28							
8								29							
9								30							
10								31							
11								32							
12								33							
13								34							
14								35							
15								36							
16								37							
17								38							
18								39							
19								40							
20								41							
21								42							
F1								F2							
F3								F4							
F5								F6							
F7								F8							

Figure 33. First page of fish data sheets.

3.3.14.3 Electrofishing

To maximize personal safety and minimize fish injury, a person with electrofishing experience and formal training should oversee BURP electrofishing. Effective but safe electrofishing requires understanding electricity in water, electrofishing safety, and electrofishing principles. Starting in 2004, DEQ will require electrofishing units to be certified annually by the factory. All DEQ employees must follow DEQ electrofishing policy. BURP Coordinators are responsible for making sure all crew members have read and understood the electrofishing safety information included in this manual as Appendix H and have signed the acknowledgement that they received electrofishing safety orientation before they do any electrofishing.

3.3.14.3.1 Electrofisher Preparation

Use standardized electrodes for BURP electrofishing. The cathode should be the "rat-tail" type with three times the surface area of the anode. The anode should be round, shiny, and 28 to 30 cm in diameter. Remove all plating from the anode with an abrasive pad weekly or as needed.

3.3.14.3.2 Electrofisher Settings

Electrofisher units should use pulsed DC set to the lowest voltage, frequency, and duty cycle combination that elicits galvanotaxis response and minimizes tetanus. Table 5 gives initial and maximum electrofisher settings recommended for BURP electrofishing.

Table 5. Guidelines for Initial and Maximum Setting Recommmendations for BURP Electrofishers

	Initial Settings	Maximum Settings
Voltage	100 V	1100 V for conductivity < 100 µS/cm[1] 800 V for conductivity[1] 100 – 300 µS/cm[1] 400 V for conductivity[1] > 300 µS/cm[1]
Pulse width	500µs[2]	5 ms[3]
Duty cycle	0.7%	30%
Frequency	15 Hz[4]	60 Hz[4]

1. microsiemens per centimeter
2. microseconds
3. milliseconds
4. hertz

3.3.14.3.3 Electrofishing Method

Be sure the site surveyed for fish includes all habitat types present in the reach if any are different than the BURP site. Electrofish a minimum of 100 meters of the stream reach after collecting macroinvertebrate and periphyton samples.

Follow the steps below for electrofishing and gathering the data from the fish:

- At a minimum, make one upstream pass without block nets. Proceed up the thalweg of the channel for streams whose wetted width is less than 5 meters and in a zigzag pattern in larger streams.
- Collect all fish. Assure that all collected fish are maintained in cool, well-oxygenated water. Take care to avoid damage or injury to the fish. Identify all fish to the lowest taxonomic level possible. Prepare equipment for measuring length (scales for weighing are optional) and the recovery chamber prior to applying anesthesia. Apply anesthesia as recommended in Chandler et al. (1993).
- Measure the total length of each fish.
- Voucher fish specimens as described below.
- Record the amount of time (number of seconds) spent on each electrofishing pass.
- Measure and record the specific conductivity in microsiemens per centimeter.
- Measure and record the water temperature.
- If the electrofished site is different than the BURP site, record latitude and longitude, stream length of the site, and average width at a minimum of three transects.
- Record fish type, length, weight (optional), and tag number for each vouchered fish.
- Group the fish by species. Use a different alphabetical character for all the fishes that appear to be the same species.
- Note the DEQ taxon code for each individual (see Appendix I).

3.3.14.4 Fish Vouchering

3.3.14.4.1 Vouchering Purpose

Vouchering of fish specimens is a QA procedure at DEQ and is a routine step in "good biological science." Lundberg and McDade (1990) recommend vouchering specimens for additional taxonomic identification and eventual deposit in a museum. The depository for DEQ fish (and macroinvertebrate) voucher specimens is the Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell. Vouchered specimens can also be used for public education, staff training, and research and evidence in beneficial use attainability, status, and environmental investigations.

3.3.14.4.2 Vouchering Policy

Voucher any fish that can not be identified to species in the field and some that have been field-identified for confirmation. Voucher enough specimens of each species from each site to document the range of size and individual characteristics of each species at that site. Five or six specimens of each species from each site is usually enough.
Vouchering of fish specimens must comply with any applicable scientific collection regulations and restrictions, particularly those specified in permits. DEQ fish collection permits need to specify the Orma J. Smith Museum as the depository for the vouchered material. The museum also needs a photocopy of the collection permit to document legal possession of vouchered materials.

3.3.14.4.3 Vouchering Procedures

1. Before beginning, read the formalin health and safety information in Appendix E of this manual.

2. **Each** fish must be tagged, using one tag per fish voucher. If possible, use a tag applicator (Quiltak or similar) to tag voucher fish with a Floy™ tag label. Tag small fish through the body below the dorsal fin on the right side, and tag larger fish into the body just below the dorsal fin on the right side. Figure 34 shows a tag placed through the body of a small fish. If it is not possible to use the tag applicator, use a wire through the mouth to attach the tag.

Figure 34. Small fish tagged through the body

3. Place tagged live specimens in 10% formalin solution as a fixing agent. Using live specimens allows the formalin solution to be ingested and respirated into the interior organs and tissues of the fish. If a specimen is over 300 mm (one foot) in total length, make a small incision in the abdomen and/or inject formalin into the large muscles. Be sure all the specimens are totally covered with formalin.

4. Label each sample jar according to the example in Figure 35. Each label must have at least the following: 1) stream name (water body), 2) site ID, 3) date, 4) collector's name, and 5) the jar count (e.g., 1 of 3, 2 of 3). When including paper labels with fish use archival grade heavy paper that can withstand storage in formalin solution (such as Resistall Paper 36#). Use alcohol-proof ink. Place one label inside the jar and tape a second label to the outside of the jar.

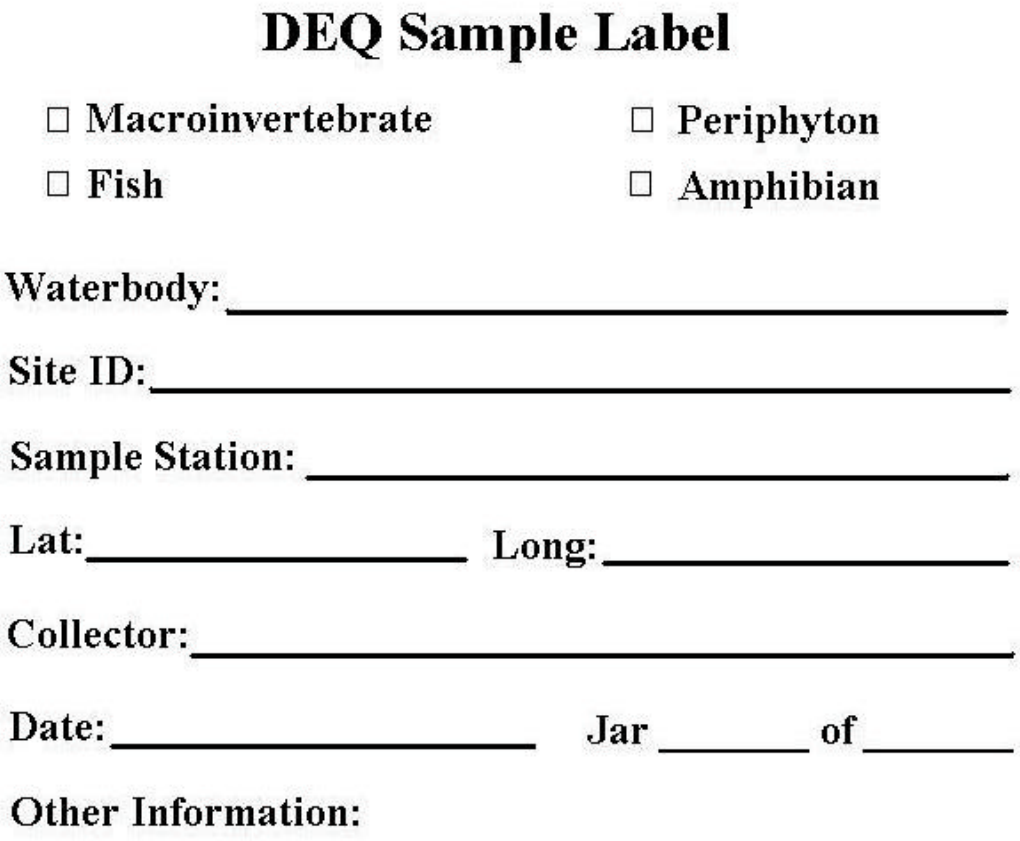


Figure 35. Sample of a fish label.

5. Ideally, each site should have one jar for all vouchered fish. The jars containing fish should be easy to distinguish from the jars containing other types of vouchered specimens. One way of ensuring this is to put a "Mr. Yuk" sticker on the fish jars.

6. The fish specimens from any one crew (region) must be kept separate from those of other crews and from other types of specimens. Do not mix fish and macroinvertebrate samples or different crews' fish samples together in one box. Each box of samples must be labeled with: 1) the regional (or state) office it is from, 2) the site IDs of the samples in the box, and the box count and total number of boxes (i.e., box 1 of 5, 2 of 5, etc.).

7. Before submitting the specimens to the lab for analysis, fill out the fish data sheet(s) (part of the BURP field forms) relating tag numbers to DEQ fish specimen labels. Make an initial field identification of the specimens being vouchered. Follow QA/QC instructions for lab submittal. Include the fish data sheet(s) with samples submitted to the lab.

8. When the monitoring season is finished, send all the samples (for one crew/region) to the laboratory in one shipment. Do not mix samples from more than one region in any one shipment to the laboratory. Notify the lab before sending samples. If possible, call the lab before the end of the season with a reliable estimate of the number of samples they will receive. This allows the laboratory to order necessary supplies and schedule employees to complete the work.

9. Send a legible copy of the field data sheets (original is preferred), a copy of the collection permit, and the specimens to the data management representative in the DEQ state office.

Idaho Division of Environmental Quality

Bacteria Check Sheet

Stream Name:		Site ID:	
HUC #:		Collection Date:	

1	Is Primary Contact Recreation a Designated or Existing Use	Yes	No	If Yes collect 1 sample *****
				if No collect 1 sample *******
2	Are upstream land uses affecting recreation use **	Yes	No	if Yes collect 1 sample *******
3	Other reasons ***	Yes	No	if Yes collect 1 sample *******

explain other reasons

collect 1	
collect 5	

** include agriculture, grazing, recreation, urban, cabins, septic

*** on 303d list for bacteria, etc.

***** if e-coli exceeds 406/100ml, collect 5 samples over 30 days

******* if e-coli exceeds 576/100ml, collect 5 samples over 30 days

Sample Results

sample #	date	time	location	E-coli results
sample #1				
sample #2				
sample #3				
sample #4				
sample #5				
sample #6				
			geometric mean	

* if sample #1 exceed standards, collect remaining 4 samples

other notes:

Figure 36. Sample of a Bacteria Field Form / Check Sheet

3.3.15 Bacteria (E. coli) Check Sheet

E. coli (Escherichia coli) is a bacteria found in the normal intestinal flora of warm-blooded animals. Its presence in water indicates that the water has been in contact with or been contaminated by fecal material, so BURP uses it as an indicator for bacteria and other pathogens. Although BURP currently analyzes for *E. coli*, the samples collected by this method could be analyzed for other bacteria.
Numerical criteria for *E. coli* are included in the state of Idaho water quality standards for protecting primary and secondary contact recreation beneficial uses (IDAPA 58.01.02.210.01-.02). The designated beneficial use is determined in the office before the field visit..

Each site is screened, using the process described below, to determine if the site potentially has sources of *E. coli*. If it does, a bacteria sample is collected from the site and submitted for laboratory analysis. If that sample contains *E. coli* at a level that exceeds a standard threshold, five additional samples are collected within 30 days.

3.3.15.1 Bacteria Screening

At each BURP survey site, follow the screening process and complete the screening form shown in Figure 36 to determine if bacteria sampling is required.
DEQ's screening process uses the following questions:

- Is primary contact recreation a designated beneficial use? If **yes**, apply primary contact recreation threshold values for exceedances.

- Are swimming/bathing areas located within the reach; is there evidence of swimming/bathing within the reach; has swimming/bathing been observed in the reach? If **yes**, apply primary contact recreation threshold values for exceedances.

- Do upstream land uses have the potential for increasing bacteria concentration? Examples of such land uses are agriculture, grazing, urban development, waste water treatment facilities, septic tanks, and cabins. If **yes**, apply secondary contact recreation threshold values for exceedances.

- Are there other reasons that bacteria should be collected? For example, has the stream had bacteria problems in the past? Has the public filed complaints on the stream? Are there other reasons to expect a bacteria problem? If so provide a description of these reasons. **For any of these reasons**, apply secondary contact recreation threshold values for exceedances.

If any of the above questions were answered yes, collect one grab sample for laboratory analysis, using the method given below. If an exceedance of the applicable threshold value occurs according to the criteria given below, follow up by collecting five samples within a 30-day period.

To determine if a threshold exceedance has occurred (requiring additional sample collection), refer to the Idaho water quality standards, IDAPA 58.01.02.210.01-.02. The threshold values for *E. coli* bacteria are currently 406 organisms per 100 ml for primary contact recreation and 576 organisms per 100 ml for secondary contact recreation.

3.3.15.2 Bacteria Sample Collection

For BURP monitoring, bacteria samples must be taken following standard methods (American Public Health Association 1998). Follow these guidelines:

- Take bacteria samples in nonreactive borosilicate glass or plastic bottles that the laboratory has prepared. The laboratory should then add sodium thiosulfate ($Na_2S_2O_3$). Sodium thiosulfate dechlorinates and neutralizes any residual halogens that prevent continuation of bacterial action during sample transit. Sodium thiosulfate is usually intended for dechlorinating chlorinated wastewater effluents and drinking water. The use of sodium thiosulfate may not be necessary for surface waters (unchlorinated) but its use is recommended for standardization and will not negatively affect surface water samples. If you must prepare them, be sure they are cleaned and rinsed carefully, given a final rinse with deionized or distilled water, and sterilized.

- When filling a sample bottle, leave ample air space (at least 2.5 cm) to facilitate mixing by shaking before examination.

- Collect samples from the thalweg of the stream.

- Use aseptic techniques to avoid sample contamination. Leave each sample bottle closed until it is to be filled. Remove the stopper or cap as a unit; do not contaminate the inner surface of the stopper or cap and neck of the bottle. Fill the bottle without rinsing. Replace the stopper or cap immediately. The volume of the sample should be sufficient to carry out all tests required, preferably not less than 100 ml.

  Follow these collection steps:

  1. Stand facing upstream in the thalweg at the sample collection location.

  2. Remove the sample bottle cap.

  3. Invert the sample bottle and dip it to arm's length, not more than 80% of depth.

  4. Revert the bottle while drawing upward; this approximates depth integration.

  5. Pour out excess water to leave ample air space.

  6. Recap the sample bottle.

  7. Place the sample in a cooler with ample ice to maintain 4 °C.

  8. Deliver the sample to the laboratory within the specified holding time, currently 30 hours.

9. Do not submit samples for analysis if they have exceeded the holding time specified by the laboratory. Currently the state laboratory closes at 4:30, so bacteria samples must be there by 4:00.

- Perform the following QA protocols for bacteria sampling:

1. Collect 10% "blank" samples (i.e., after every 10 samples, collect one blank) by substituting steps 3 and 4 above with filling a sample bottle with deionized water.

2. Also collect 10% duplicate samples (i.e., after every 10 samples, collect one duplicate).

3. Always complete proper labeling and field documentation to demonstrate compliance with sampling protocol and to reduce contamination of sample bottles.

4 Completing Followup of BURP Field Activities

After the main field activities are finished, there are a few things that must be done before leaving the site, while leaving the site, and after returning to the office. They are shown in the last box in Figure 37.

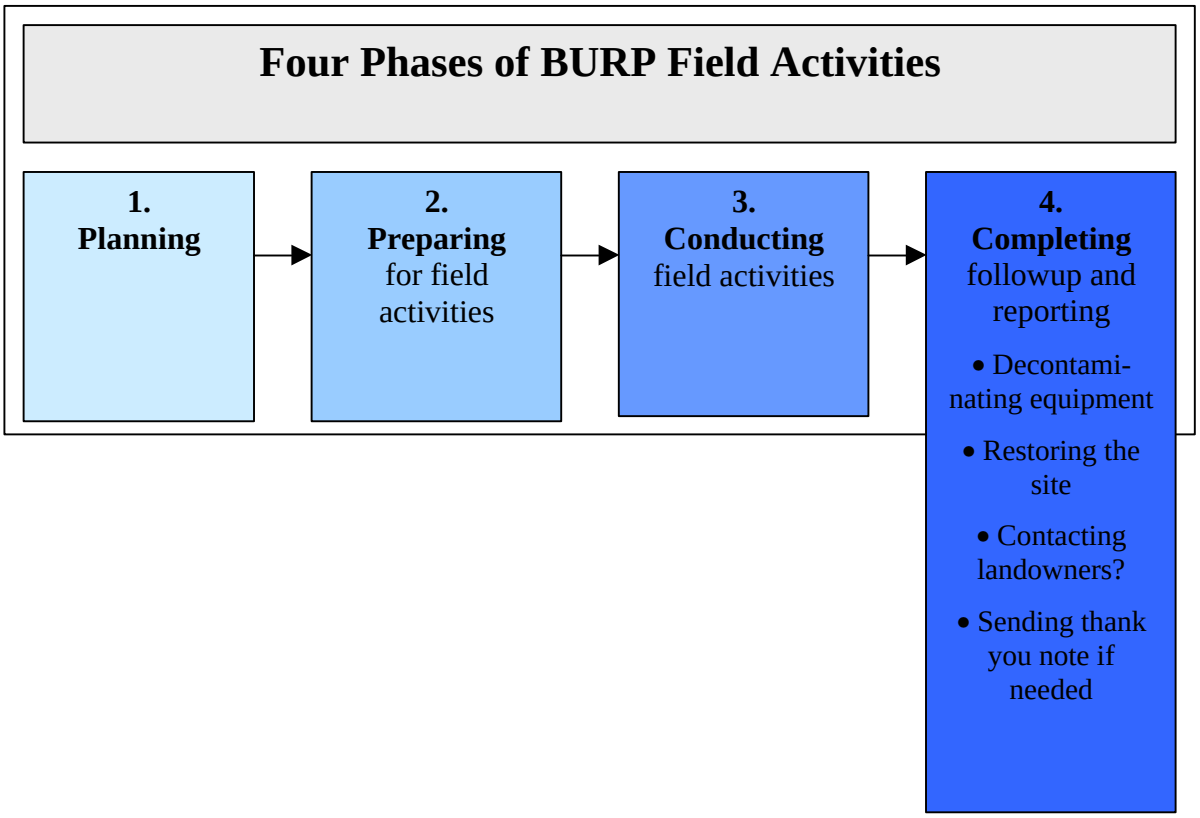


Figure 37. Steps in the Followup phase.

4.1 While Still in the Field

4.1.1 Decontaminating Equipment

Decontamination entails making BURP equipment and the area safe by eliminating harmful substances.

DEQ does not want its monitoring activities to cause the spread of noxious weeds, diseases of aquatic organisms, or exotic flora and fauna. Take special care to perform decontamination steps before moving from one area to another.

The basic method BURP uses to avoid the spread of weed seeds, diseases, and exotic organisms is simple sanitation. This sanitation can mostly be accomplished by keeping waders, monitoring

equipment, and vehicles clean of mud and debris (Oregon Department of Environmental Quality 2001). Clean or rinse any contaminated items with water to thoroughly remove mud, weeds, and other debris. Dry them completely.

The U.S. Fish and Wildlife Service (2001) recommends the following for the prevention of the spread of the New Zealand mudsnail: rinse and clean sampling gear, waders, and equipment after each use; use separate sets of sampling or wading gear; and give equipment a hot-water bath (50 °C, 120 °F) for several minutes. They also note that dry heat will kill the New Zealand mudsnail and that waders can be sprayed with soap solutions and allowed to dry in the hot sun for several hours.

The Oregon Department of Environmental Quality (2001) recommends soaking equipment in a 10% chlorine bleach solution for 10 minutes to kill whirling disease spores. Follow by rinsing and drying equipment in the shade. They caution that chlorine is a reactive chemical that can damage some equipment with prolonged contact.
Lazorchak (2001) and Lazorchak and Averill (2001) recommend cleaning up and properly disposing of all waste material generated at the stream or river sampling site and transporting it out of the area as necessary.

4.2 When Leaving a Site

4.2.1 Restore the Site to the Way it Was Upon Arrival

Make every effort to restore the site to the condition it was in when the crew arrived. Be sure to remove all markers, stakes, and ribbons as well as all equipment and supplies. Leave all gates as they were; open if they were open and closed if they were closed. If at all possible, avoid driving over soft terrain which can leave damaging vehicle tracks.

4.2.2 Contact the Landowner

Many private landowners and public lands caretakers appreciate being contacted by the BURP crews as they leave a site. If it is feasible, try to contact the landowner or caretaker when leaving to express thanks and to notify them of your departure from the property. It is often helpful to convey any positive comments regarding their property or the stream. If they ask about indications of impairment, be honest but do not theorize or place blame for any degraded conditions you observed.

4.3 Back in the Office

There are several things that must be done back in the office, some immediately, some within a few days:

- Submit samples to the lab.
- Handle data properly, filing notes and other information.
- Send thank you notes to landowners and caretakers that you didn't contact in person when leaving their sites.

5 Quality Assurance and Quality Control

The data collected in the field is of little use unless its quality is assured by QC practices. In order for DEQ to make maximum use of the BURP data, it is essential that the BURP protocols in this field manual and the QC practices in the QA/QC manual, *Beneficial Use Reconnaissance Program Quality Assurance Plan for Field Data Sheets and Data Handling on Wadeable (Small) Streams (IDEQ 2002) are followed.*

Collection of reliable and accurate monitoring and measurement data is the goal of the QA program. DEQ's QA program enhances data accuracy, reliability, and consistency, through 1) annual BURP Coordinator workshops, 2) extensive BURP field crew training, 3) consistent crew supervision, 4) comprehensive field audits, and 5_) various QA/QC activities. Each of these is discussed below.

5.1 BURP Coordinator Workshops

Each year, BURP coordinators review BURP protocols, to learn new BURP methods, and exchange ideas on improving data collection efficiency and accuracy during several meetings and one workshop The workshop is conducted before each field season and provides training materials and instruction methods, training on new methods, and examples of properly recorded measurements. If any protocols are changed, the BURP Field Manual is updated accordingly.

5.2 Crew Management

Because of the many variables measured and samples taken, training the seasonal crews is essential for the success of the BURP program. DEQ strives for statewide consistency of the monitoring data and has chosen mandatory centralized training of the BURP field crews as the best way to accomplish this objective. All crew members receive comprehensive and consistent training about DEQ policies and BURP methods. This includes new crew members and "returnees," those who have worked on a BURP crew before. Crews are usually trained during the last two weeks in June, before the field season starts July 1. Currently, the training takes eight full days. It includes a small amount of lecture in the office, but is mainly done in the field. The crews learn all aspects of the methods presented in the BURP Field Manual. The majority of the training consists of hands-on demonstrations first by the DEQ instructors, then by the crew members, to demonstrate their ability to perform each method. Other training methods include viewing instructional materials and lecture and discussion sessions. The crews are introduced to as many different types of streams, land uses, and ecoregions as possible during the training.

BURP crew members receive extensive training before beginning field work. They learn the correct procedures for taking samples and measurements and how to properly fill out the BURP field forms, an important part of accurate data entry and overall quality assurance. In addition, they receive important information about personal safety, QC, vehicle and equipment maintenance, and proper etiquette.

5.3 Supervision of Crew Adherence to Standards

Each BURP crew is supervised throughout the monitoring season by a BURP Coordinator who accompanies crews periodically throughout the monitoring season to ensure their continuing adherence to the BURP Field Manual and DEQ policy.

5.4 Field Audits

A field audit team consists of one or more members of the DEQ state office staff, accompanied by a BURP Coordinator from another DEQ region who was involved with the centralized BURP crew training. The audit team observes BURP crews performing measurements and collecting and preserving samples at a BURP site. Each BURP crew is audited within approximately two weeks of crew training. Each crew is audited at least once per season. The BURP Coordinators use the audit findings to ensure the crew's performance is consistent and adheres to BURP methods to meet QA requirements.

After the audit is completed, the audit team briefs the BURP crew on-site. The audit team prepares a written report of the audit results immediately following the audit and distributes it to DEQ regional managers, BURP Coordinators, and other staff.

5.5 Quality Assurance

5.5.1 Data Handling

Data handling by BURP crews and coordinators prior to submittal to the state office is considered part of the sampling process. The data handling process at the state office is guided by the most recent version of the QA/QC manual (currently, the *Beneficial Use Reconnaissance Program Quality Assurance Plan For Field Data Sheets and Data Handling on Wadeable (Small) Streams* [DEQ 2002]). Briefly, the QA process requires review of data sheets by the DEQ state office QA crew and data entry by DEQ's data management staff in the state office Technical Services Division.

5.5.2 Sample Handling

BURP crews are trained to handle all samples as gently as possible and to take extra care with macroinvertebrate samples, as excessive shaking and jarring can destroy macroinvertebrate samples. Crews are also trained on how to label samples correctly and on the importance of correct labeling.

5.5.3 Sample Vouchering

New (1998) and Bailey et al. (2001) strongly recommend that voucher specimens be archived for future reanalysis, identification, and other research. Voucher specimens should be stored in appropriate containers and preservatives. Voucher labels should include necessary information such as location, date, and collector's name, and be printed on archival paper. Presently, most BURP specimens are deposited in the Orma J. Smith Museum of Natural History, Albertson College of Idaho, Caldwell. Amphibian specimens are also deposited at the Idaho Museum of Natural History, Idaho State University, Pocatello. Voucher specimens that are deposited at the

museums are then available for any later verification that might be needed and for future research opportunities. DEQ will continue to support voucher specimens as resources allow.

5.5.4 Equipment Calibration

Calibrating the equipment means adjusting precisely for a particular function.
In order to obtain the most accurate and precise information, the BURP Coordinators are responsible for calibrating or standardizing each piece of monitoring equipment that requires it before each field season. Calibrating a piece of equipment tells how accurate its measurements are. Equipment calibration also insures the integrity of the data.
Before the beginning of each monitoring year, the conductivity meter, flow meter, and electrofishing unit must be sent in for factory calibration and maintenance. The field crew inspects the lab-grade and field thermometers weekly and calibrates them monthly to confirm instrument integrity. The field crew also calibrates the conductivity meter monthly. The crew maintains a calibration log for each instrument.

5.6 Data Analysis and Interpretation

This field manual describes how to conduct a survey following the BURP process. This description includes BURP survey assumptions, methods, data handling, and required equipment. This document is not intended to describe the analysis and interpretation of the data collected. That information is found in the *Water Body Assessment Guidance* (Grafe et al. 2002a).

6 Safety

DEQ takes safety very seriously. Consequently, there are several policies to ensure safety when performing monitoring activities. These include mandatory training in cardiopulmonary resuscitation (CPR) and first aid, hazardous substances, and electrofishing safety. DEQ also provides comprehensive training regarding employment and safety policies during regional orientation and centralized training.

6.1 CPR and First Aid

All BURP crew members and DEQ staff who perform monitoring activities must be trained and certified in CPR and first aid to increase safety during all BURP field work, particularly during training and electrofishing.

6.2 Hazardous Situations and Substances

6.2.1 Hazardous Materials

No BURP crew member is authorized to endanger his life or the lives of others with exposure to hazardous materials, laboratory waste, or drug paraphernalia. DEQ provides training to help identify potentially hazardous substances and situations that may be found at monitoring sites or during travel. This training is intended to provide awareness and to help crew members recognize these materials if they are encountered. Crew members are not trained or authorized to deal with hazardous materials found in the field. BURP Coordinators in consultation with HazMat Coordinators are encouraged to develop their own additional training programs specific to their regional areas.

Crew members are not authorized to collect or transport hazardous materials found in the field. However, they are authorized to determine the GPS coordinates of a site if it can be done without undue exposure and to report the site to the BURP Coordinator, who will then report it to the regional office HazMat Coordinator. Safety comes first in any situation.

BURP crews use a reduced concentration of formalin to preserve some samples in the field (currently fish and periphyton). Appendix E provides information on how to handle formalin safely.

6.2.2 Abandoned Mining Sites

BURP training includes awareness of safety issues surrounding abandoned mining sites. Crew members are not authorized to visit or enter abandoned mine land sites (especially adits and tunnels) without notifying the BURP Coordinator and the Abandoned Mine Lands Coordinator. BURP crews are not authorized to take water samples from abandoned mine land sites where ground water is discharging into a surface stream.

6.2.3 Laboratory Waste and Drug Paraphernalia

BURP training includes discussions of safety and health issues surrounding laboratory waste and drug paraphernalia that sometimes appears on public lands. Crew members are not authorized to collect or transport laboratory waste or drug paraphernalia without written authorization from the Regional Manager for Water Quality Protection. If possible without exceeding the exposure level or otherwise risking the health and safety of crew members and others, crew members may take GPS readings of the site (or near the site) and to report them to the BURP Coordinator, who will then report them to the HazMat Coordinator immediately for follow up.

6.3 Electrofishing

DEQ has several policies to address electrofishing safety issues. Specifically, DEQ has an electrofishing safety plan (Appendix H) that addresses safety issues concerning training, equipment, and procedures. BURP Coordinators, crew members, and other DEQ staff performing electrofishing activities must carefully review these policies and sign a form acknowledging they have received electrofishing orientation. DEQ also uses an electrofishing checklist to ensure equipment needs are met and safety issues are addressed (Appendix J).

7 Literature Cited

Allen, J.D. 1995. Stream ecology: structure and function of running waters. Chapman and Hall, London, England.

Armantrout, N.B. 1998. Glossary of aquatic habitat inventory terminology. Western Division American Fisheries Society, Bethesda, Maryland. 136 pp.

Bahls, L.L. 1993. Periphyton bioassessment methods for Montana Streams. Montana Water Quality Bureau, Department of Health and Environmental Science, Water Quality Bureau, Helena, Montana.

Bailey, R.C., R.H. Norris, and T.B. Reynoldson. 2001. Taxonomic resolution of benthic macroinvertebrate communities in bioassessments. Journal of the North American Benthological Society 20(2):280-286.

Bain, Mark B. 1999. Substrate, pp. 95-103, IN: M.B. Bain and N.J. Stevenson (eds.) Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Barbour, M.T., J. Gerritsen, B.D. Synder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates and fish, second edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water, Washington, D.C. xi + 306 pp.

Bauer, S.B. and T.A. Burton. 1993. Monitoring protocols to evaluate water quality effects of grazing management on western rangeland streams. USEPA. Seattle, Washington 910/R-93-017.

Baxter, G.T., and M.D. Stone. 1985. Amphibians and reptiles of Wyoming. Wyoming Game and Fish Department, Laramie. 137 pp.

Bauer, S.B. and S.C. Ralph. 1999. Aquatic habitat indicators and their application to water quality objectives within the Clean Water Act. EPA-910-R-99-014. U.S. Environmental Protection Agency, Region 10, Seattle, Washington. 99 pp.

Behler, J.L., and F.W. King. 1997. National Audubon Society field guide to North American reptiles and amphibians. Knopf, New York. 743 pp.

Beschta, R.L. and W.S. Platts. 1986. Morphological features of small streams: Significance and function. Water Resources Bulletin: 22 (3):369-377.

Braudrick, C.A. and G.E. Grant. 2000. When do logs move in rivers? Water Resources Research: 36(2) 571-583.

Burton, T.A., and G.W. Harvey. 1990. Estimating Intergravel Salmonid Living Space using the Cobble Embeddedness Sampling Procedure. Idaho Department of Health and Welfare,

Division of Environmental Quality, Water Quality Bureau. Water Quality Monitoring Protocols - Report No. 2. Boise, Idaho. 20 pp.

Burton, T. A. 2002, in review. Bank Stability. USDI. Bureau of Land Management. Idaho State Office, Boise, Idaho.

Bury, R.B., and P.S. Corn. 1991. Sampling methods for amphibians in streams in the Pacific Northwest. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR- 275, Portland, Oregon. 29 pp.

Chandler, G.L., T.R. Maret, and D.W. Zaroban. 1993. Protocols for assessment of biotic integrity (fish) in Idaho streams. Water Quality Monitoring Protocols Rpt. 6, Idaho Department of Health & Welfare, Division of Environmental Quality, Boise. 40 pp.

Chapman, D.W. 1966. Food and space as regulators of salmonid populations in streams. American Naturalist 100:345-357.

Chapman, D.W., and K.P. Mcleod. 1987. Development of criteria for fine sediment in the northern Rockies ecoregion. USEPA, 910/9-87-162, Washington D. C.

Clark, W.H. 1990. Coordinated nonpoint source water quality monitoring program for Idaho. Idaho Department of Health & Welfare, Division of Environmental Quality, Boise. 139 pp.

Clark, W.H., 2003. Beneficial Use Reconnaissance Program 2003 Annual Work Plan for Streams. Idaho Department of Environmental Quality, Boise, Idaho, 20 pp.

Clark, W.H. and R.E. Gregg. 1986. Housing arthropods and other invertebrates stored in alcohol. Entomology News 97(5):237-240.

Clark, W.H. and T.R. Maret. 1993. Protocols for assessment of biotic integrity (macroinvertebrates) for wadeable Idaho Streams. Water Quality Monitoring Protocols Report 5, Idaho Division of Environmental Quality, Boise, Idaho.

Collins, W.D. 1925. Temperature of water for industrial use. USGS Water Supply Paper 520-F.

Conquest, L.L., R.J. Naiman and S.C. Ralph. 1994. Implementation of large-scale stream monitoring efforts: Sampling design and data analysis issues, 69-90 pp. In L. Loeb and Spacie (eds). Biological monitoring of aquatic systems. Lewis. New York, New York.

Corkran, C.C., and C. Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia. Lone Pine Publishing, Vancouver, British Columbia. 175 pp.

Corn, P.S. 1994. What we know and don't know about amphibian declines in the west, pp. 59-67, IN: W.W. Covington and L.F. DeBano (eds.), Sustainable ecological systems: implementing an ecological approach to land management. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO, General Technical Report RM-247.

Corn, P.S., and R.B. Bury. 1990. Sampling methods for terrestrial amphibians and reptiles. U.S. Department of Agriculture, Forest Service, General Technical Report PNW-GTR- 256, Portland, Oregon. 34 pp.

Cowley, E.C. 1992. Protocols for classifying, monitoring, and evaluating stream segments. Water Quality Monitoring Protocols Report #8, Idaho Division of Environmental Quality, Boise, Idaho.

Crisp, D.T., and G. Howson. 1982. "Effect of air temperature upon mean water temperature in streams in the north Pennines and English Lake District." Freshwater Biology 12:359-367.

Davis, J.C., G.W. Minshall, C.T. Robinson, and P. Landres. 2001. Monitoring wilderness stream ecosystems. General Technical Report RMRS-GTR-70. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah. 137 pp.

Dolloff, C.A., D.G. Hankin, and G.H. Reeves. 1993. Basinwide estimation of habitat and fish populations in streams. USDA Forest Service Gen. Tech. Rep. SE-83.

Environmental Protection Agency (EPA). 1999. Benthic macroinvertebrate protocols: revision to rapid bioassessment protocols for use in streams and rivers: Periphyton, benthic macroinvertebrates, and fish. USEPA, Washington, D.C.

Essig, D.A. 1998. The dilemma of applying uniform temperature criteria in a diverse environment: an issue analysis. Idaho Division of Environmental Quality, Boise. 29 pp.

Everest, F.H., R.L. Beschta, C.J. Cederholm, K.V. Koski, J.C. Scrivener, and J.R. Sedell. 1987. Fine sediment and salmonid production: A paradox; pp. 98-142. In E.O. Salo and T.W. Cundy ed. Streamside management: Forestry and fishery interaction. College of Forest Resources, University of Washington, Seattle, Washington.

Fichter, E., and A.D. Linder. 1964. The amphibians of Idaho. Special Publication, The Idaho State University Museum, Pocatello.

Fore, L. and W. Bollman. 2000. Stream habitat index. In Grafe, C.S. (editor). Idaho stream ecological assessment framework: an integrated approach. State of Idaho Department of Environmental Quality. Boise, Idaho. 107 pp.

Fraley, J., D. Read, and P. Graham. 1981. Flathead River fishery study - 1981. Montana Department of Fish, Wildlife and Parks, Helena.

Franson, M.A. (ed). 1998. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Standard Methods for the examination of water and wastewater (20th ed.): Washington D.C., American Public Health Association. 1,191 pp.

Gallagher, A.S. and N.J. Stevenson. 1999. Streamflow, pp. 149-157, *IN*: M.B. Bain and N.J. Stevenson (eds.) Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Gordon, N.D., T.A. McMahon, and B.L. Finlayson. 1992. Stream hydrology: an introduction for ecologists. John Wiley and Sons, New York. 526 pp.

Gorman, O.T., and J.R. Karr. 1978. Habitat structure and stream fish communities. Ecology 59(3):507-515.

Grafe et al. 2002a. Water Body Assessment Guidance (Second Edition) (WBAG) document. Idaho Department of Environmental Quality, Boise, Idaho.

Grafe, C.S. 2002b. Water Body Size Criteria. *In* Grafe, C.S. (editor). Idaho Small Stream Ecological Assessment Framework: An Integrated Approach. Idaho Department of Environmental Quality. Boise, Idaho. pp. 2-1 – 2-5.

Graham, P.J., D. Read, S. Leathe, J. Miller, and K. Pratt. 1980. Flathead River basin fishery study - 1980. Montana Department of Fish, Wildlife and Parks, Helena.

Groves, C.R., B. Butterfield, A. Lippincott, B. Csuti, J.M. Scott. 1997. Atlas of Idaho's wildlife. Idaho Department of Fish and Game, Boise. 372 pp.

Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. USDA Forest Service. RM-245.

Hawkins, C.P., J.L. Kershner, P.A. Bisson, M.D. Bryant, L.M. Decker, S.V. Gregory, D.A. McCullough, C.K. Overton, G.H. Reeves, R.J. Steedman, and M.K. Young. 1993. A hierarchical approach to classifying stream habitat features. Fisheries 18(6):3-12.

Hayslip, G.A. (ed.). 1993. Region 10 in-stream biological monitoring handbook for wadeable streams in the Pacific Northwest. EPA 910/9-92-013, U.S. Environmental Protection Agency, Seattle, Washington. 75 pp.

Helm, W.T., P. Brouha, M. Aceituno, C. Armour, P. Bisson, J. Hall, G. Holton, and M. Shaw. 1985. Glossary of stream habitat terms. American Fisheries Society, Western Division, Bethesda, Maryland. 34 pp.

Hem, J.D. 1985. Study and interpretation of the chemical characteristics of natural water. U.S. Geological Survey Water-Supply Paper 2254. U.S. Geological Survey, Alexandria, Virginia. 263 pp.

Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L-A. C. Hayek, and M.S. Foster, eds. 1994. Measuring and monitoring biological diversity, standard methods for amphibians. Smithsonian Institution Press, Washington, D.C. 364 pp.

Hoelscher, B. and T.C. Bjornn. 1989. Habitat, densities, and potential production of trout and char in Pend Oreille Lake tributaries. Idaho Department of Fish and Game, Federal Aid in Fish Restoration, Project F-71-R-10, Job 8, Job Completion Report, Boise.

Horton, G.A. 2001. Dictionary of water words, a compilation of technical water, water quality, environmental, natural resource, and water-related terms. Great Basin Research, Reno, NV. 544 pp.

Hughes, R.M. 1995. Defining acceptable biological status by comparing with reference conditions. In Davis, W.S. and T.P. Simon (eds.), 1995. Biological assessment and criteria: tools for water resource planning. CRC Press, Boca Raton, Florida. pp. 31-48.

Hunt, R.L. 1969. Effects of habitat alteration on production, standing crops and yield of brook trout in Lawrence Creek, Wisconsin. *In*. T.G. Northcote, editor. Symposium on salmon and trout in streams. H.R. Macmillan Lectures in Fisheries, University of British Columbia, Vancouver.

HYDROLAB Corporation. 1993. $H_2O^{®}$ water quality multiprobe operation manual. Austin, Texas.

Idaho Department of Health and Welfare. 1996. 1996 Beneficial Use Reconnaissance Project workplan. Idaho Department of Health and Welfare, Division of Environmental Quality, Beneficial Use Reconnaissance Project Technical Advisory Committee, Boise, Idaho.

IDAPA. Water Quality Standards and Wastewater Treatment Requirements. IDAPA 16. Title 01. Chapter 2.

Irving, D.B. 1987. Cutthroat trout abundance, potential yield, and interaction with brook trout in Priest Lake tributaries. Master's thesis. University of Idaho, Moscow.

Johnson, R.K., T. Wiederholm, and D.M. Rosenberg. 1993. Freshwater biomonitoring using individual organisms, populations, and species assemblages of benthic macroinvertebrates. D.M. Rosenberg and V.H. Resh (eds.). Freshwater Biomonitoring and Benthic Macroinvertebrates. 4:40-158. Chapman and Hall, New York, New York.

Koch, E.D., and C.R. Peterson. 1995. Amphibians & reptiles of Yellowstone and Grand Teton National Parks. University of Utah Press, Salt Lake City. 188 pp.

Kolz, A.L. 1993. In-water electrical measurements for evaluating electrofishing systems. Biological Report 11. U.S. Fish and Wildlife Service, Washington, D.C. 24 pp.

Kunkle, S., W.S. Johnson, and M. Flora. 1987. Monitoring stream water for land-use impacts. National Park Service, Water Resources Division, Fort Collins, Colorado.

Lazorchak, J.M. 2001. Final site activities, p.241, IN: Peck, D.V., J.M. Lazorchak and D.J. Klemm, Environmental Monitoring and Assessment Program-surface waters: western pilot study field operations manual for wadeable streams. U.S. Environmental Protection Agency, Washington, D.C.

Lazorchak, J.M, and D.K. Averill. 2001. Final site activities, pp.185-186, IN: Peck, D.V., D.K. Averill, J.M. Lazorchak and D.J. Klemm, Environmental Monitoring and Assessment

Program-surface waters: western pilot study field operations manual for non-wadeable streams. U.S. Environmental Protection Agency, Washington, D.C.

Leonard, W.P., H.A. Brown, L.L.C. Jones, K.R. McAllister, and R.M. Storm. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, WA. 168 pp.

Leopold, L.B., W.W. Emmett, H.L. Silvey, and D.L. Rosgen. 1995. A guide to field identification of bankfull stage in the western United States. Rocky Mountain Forest and Range Experiment Station, USDA Forest Service, Fort Collins, Colorado. Videocassette, 31-minute, color.

Leupold and Stevens, Inc. 1987. Stevens® water resources data book. Leupold and Stevens, Inc., Beaverton, Oregon. 190 pp.

Linder, A.D., and E. Fichter. 1977. The amphibians and reptiles of Idaho. The Idaho State University Press, Pocatello. 78 pp.

Lundberg, J.G. and L.A. McDade. 1990. Systematics, pp. 65-108, IN: C.B. Schreck and P.B. Moyle, eds. Methods for fish biology. American Fisheries Society, Bethesda, Maryland.

Mangan, J.W. 1946. Temperatures of Natural Waters in Pennsylvania. Commonwealth of Pennsylvania, Department of Forest and Waters Report. 222p.

Marcus, M.D., B. Mullen, L.E. Noel and M.K. Young. 1990. Salmonid-habitat relationships in the western United States: A review and indexed bibliography. United States Forest Service, United States Department of Agriculture, General Technical Report RM-188, Fort Collins, Colorado.

Maret, T.R., C.T. Robinson, and G.W. Minshall. 1997. Fish assemblages and environmental correlates in least-disturbed streams of the Upper Snake River basin. Transactions of the American Fisheries Society 126:200-216.

Maret, T.R., T.A. Burton, G.W. Harvey and W.H. Clark. 1993. Field testing of new monitoring protocols to assess Brown Trout spawning habitat in an Idaho stream. North American Journal of Fisheries Management. 13(3):567-580.

Mattoon, A. 2000. Amphibia fading. Pp. 12-23, IN: Ayers, E. (ed). World Watch. 13(4). The Worldwatch Institute, Washington, D.C.

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher, 2001. Ecoregions of Idaho (color poster with map, descriptive text, summary tables, and photographs): U.S. Geological Survey, Reston, Virginia (map scale 1:1,350,000).

McIntyre, M. 1994. Idaho statewide workplan for completing beneficial use attainability and status surveys. Idaho Department of Health and Welfare, Division of Environmental Quality, Boise, Idaho.

McIntyre, M. 1993a. Beneficial use reconnaissance project coordinated water quality monitoring plan. Idaho Department of H&W, Division of Environmental Quality, Boise.

McIntyre, M.J. 1993b. Squaw creek beneficial use assessment: Gem County, Idaho. 1991-1992. Idaho Division of Environmental Quality, Boise, Idaho.

Meador, M.R., C.R. Hupp, T.F. Cuffney, and M.E. Gurtz. 1993. Methods for characterizing stream habitat as part of the national water-quality assessment program. United States Geological Survey Open-File Report 93-408, Raleigh, North Carolina.

Meixler, M.S. 1999. Water body identification, pp. 35-45, IN: M.B. Bain and N.J. Stevenson (eds.) Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Minshall, G.W. 1984. Aquatic insect-substratum relationships. 358-400 pp. In the ecology of aquatic insects, eds. V. H. Resh and D. M. Rosenberg. Prager. New York, New York.

Minshall, G.W. 1994. Stream-riparian ecosystems: Rationale and methods for basin-level assessments and management effects. In M. E. Jensen and P. S. Bourgeron ed. Volume II: Ecosystem management: Principles and applications. United States Department of Agriculture, Forest Service Pacific Northwest Research Station, Portland, Oregon. (Richard L. Everett, Eastside forest ecosystem health assessment.)

Moore, A.M. 1967. Correlation and analysis of water-temperature data for Oregon streams*:* USGS Water-Supply Paper 1819-K. 53p.

Moore, K.M.S. and S.V. Gregory. 1989. Geomorphic and riparian influences on the distribution and abundance of salmonids in a Cascade mountain stream. USDA Forest Service Gen. Tech. Rep. PSW-110.

Mulvey, M., L. Caton and R. Hafele. 1992. Oregon nonpoint monitoring protocols and stream bioassessment field manual for macroinvertebrates and habitat assessment. Oregon Department of Environmental Quality, Portland, Oregon.

Nelson, R.L., S.E. Jensen, D.P. Larsen and W.S. Platts**.** 1992. Trout distribution and habitat in relation to geology and geomorphology in the North Fork Humboldt River drainage, northeastern Nevada. Transactions of the American Fisheries Society. 121(4): 405-426.

New, T.R. 1998. Invertebrate surveys for conservation. Oxford University Press, Oxford, England. 240 pp.

Nolan, K.M. and R.R. Shields. 2000, Measurement of stream discharge by wading. Water Resources Investigations Report 00-4036, CD-ROM Version 1.1. U.S. Geological Survey, Menlo Park, California.

Nussbaum, R.A., E.D. Brodie, Jr., and R.M. Storm. 1983. Amphibians and reptiles of the Pacific Northwest. University of Idaho Press, Moscow. 332 pp.

Olson, D.H. (ed.). 1999. Survey protocols for amphibians under the survey and manage provision of the northwest forest plan, Version 3.0. Bureau of Land Management, Portland, OR. 310 pp.

Olson, D.H., W.P. Leonard, R.B. Bury. 1997. Sampling amphibians in lentic habitats. Northwest Fauna 4, Society for Northwestern Vertebrate Biology. Olympia, WA. 134 pp.

Omernik, J.M. and A.L. Gallant. 1986. Ecoregions of the Pacific Northwest. U.S. Environmental Protection Agency, Environmental Research Laboratory, EPA/600/3-86/033, Corvallis, Oregon.

Oregon Department of Environmental Quality. 2001. WQM/BIO mode of operations manual, Version 3.0. Laboratory Division, Oregon Department of Environmental Quality, Portland. 234 pp.

Osborne, L.L. and E.E. Hendricks. 1983. Streamflow and velocity as determinants of aquatic insect distribution and benthic community structure in Illinois. Water Resources Center, University of Illinois, Report No. UILU-WRC-83-183. U.S. Department of the Interior, Bureau of Reclamation.

Oswood, M.E. and W.E. Barber. 1982. Assessment of fish habitat in streams: Goals, constraints, and a new technique. Fisheries 7(4):8-11. *[note: printed in error as issue number 3]*.

Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitwell, and K.A. Duncan. 1995. User's guide to fish habitat: descriptions that represent natural conditions in the Salmon River Basin, Idaho. General Technical Report INT-GTR-322, United States Forest Service, United States Department of Agriculture, Ogden, Utah. 142 pp.

Overton, C.K., R.L. Nelson and M.A. Radko. 1993. Fish habitat conditions: Using the Northern/Intermountain regions inventory procedures for detecting differences on two differently managed watersheds. United States Forest Service, United States Department of Agriculture, General Technical Report INT-300, Ogden, Utah.

Peterson, C.R., H.J. Fabian, J.M. Beck, and D.S. Pilliod. 1996. Photographic identification cards for Idaho Amphibians. Idaho State University, Pocatello, Idaho. 23 pp.

Plafkin, J.L., M.T. Barbour, S.K. Gross, R.M. Hughes and K.D. Porter. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. Assessment and Watershed Protection Division, EPA/444/4-89-001, U. S. Environmental Protection Agency, Washington D. C. 174 pp.

Platts, W.S. 1982. Stream inventory garbage in-reliable analysis out: Only in fairy tales. *In.* N.B. Armantrout, editor. Acquisition and utilization of aquatic habitat inventory information. Western Division, American Fisheries Society, Bethesda, Maryland.

Platts, W.S**.** 1990. Managing fisheries and wildlife on rangeland grazed by livestock: a guidance and reference document for biologists. Nevada Department of Wildlife, Reno. 114 pp.

Platts, W.S., W. Megahan and G.W. Minshall. 1983. Methods of evaluating stream, riparian, and biotic conditions. United States Forest Service Intermountain Forest and Range Experiment Station, United States Department of Agriculture, General Technical Report INT-138, Ogden, Utah.

Platts, W.S., C. Armour, G.D. Booth, M. Bryant, J.L. Bufford, P. Cuplin, S. Jensen, G.W. Liekaemper, G.W. Minshall, S.B. Monsen, R.L. Nelson, J.R. Sedell and J. S. Tuhy. 1987. Methods of evaluating riparian habitats with applications to management. United States Forest Service Intermountain Research Station, United States Department of Agriculture, General Technical Report INT-221, Ogden, Utah.

Platts, W.S. and R.L. Nelson. 1989. Characteristics of riparian plant communities and streambanks with respect to grazing in northeastern Utah. In R.E. Gresswell et al. (eds.) Riparian resource management (pp. 73-81). United States Bureau of Land Management, Billings, Montana.

Plotnikoff, R.W. 1992. Timber/fish/wildlife ecoregion bioassessment pilot project. Watershed Assessments Section, Environmental Investigations and Laboratory Services Program, Washington State Department of Ecology, Olympia.

Plotnikoff, R.W. and J.S. White. 1996. Taxonomic laboratory protocol for stream macroinvertebrates collected by the Washington State Department of Ecology. Publ. No. 96-323, Washington State Department of Ecology, Olympia. 32 pp.

Pratt, K.L**.** 1984. Habitat use and species interactions of juvenile cutthroat trout (*Salmo clarki lewisi*) and bull trout (*Salvelinus confluentus*) in the upper Flathead River basin. Master's Thesis. University of Idaho, Moscow.

Radtke, D.B., J.V. Davis, and F.D. Wilde. 1998. Specific electrical conductance, Chapter 6.3, 22 pp. *IN*: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources, Section A. National Field Manual for the Collection of Water-Quality data. U.S. Geological Survey, Reston, Virginia.

Rankin, E.T. 1995. Habitat indices in water resource quality assessments, pp. 181-208, *IN*: Davis, W.S. and Simon, T.P. (eds.) Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. CRC Press, Inc., Boca Raton, Florida.

Rantz, S.E. (ed). 1982a. Measurement and computation of streamflow. Volume 1. Measurement of stage and discharge. Geological Survey Water-Supply Paper 2175. U.S. Geological Survey, Washington, D.C. 284 pp.

Rantz, S.E. (ed). 1982b. Measurement and computation of streamflow. Volume 2. Computation of discharge. Geological Survey Water-Supply Paper 2175. U.S. Geological Survey, Washington, D.C. 347 pp.

Reaser, J.K. 2000. Amphibian declines: an issue overview. Federal Taskforce on Amphibian Declines and Deformities. Washington, D.C. 31 pp.

Reynolds, J.B. 1983. Electrofishing, pp. 147-163, *IN*: Nielsen, L.A., D.L. Johnson, and S.S. Lampton, eds. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

Reynolds, J.B. 2000. Electrofishing theory, pp. 3-33, IN: Allen-Gil, S.M. ed., New perspectives in electrofishing. EPA/600/R-99/108, U.S. Environmental Protection Agency, Corvallis, Oregon.

Reichel, J., and D. Flath. 1995. Identification of Montana's amphibians and reptiles. Montana Outdoors. 20 pp.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. United States Forest Service Intermountain Research Station, United States Department of Agriculture, General Technical Report INT-302, Ogden, Utah.

Robinson, C.T., and G.W. Minshall. 1992. Refinement of biological metrics in the development of biological criteria for regional biomonitoring and assessment of small streams in Idaho. Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello.

Robinson, C.T., and G.W. Minshall. 1994. Biological metrics for regional biomonitoring and assessment of small streams in Idaho. Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello.

Rosen, B.H. 1995. Use of Periphyton in the development of biocriteria. Pp. 209-215, IN: Davis, W.S. and Simon, T.P. (eds.) Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. CRC Press, Inc., Boca Raton, Florida.

Rosenberg, D.M. and V.H. Resh. 1993. Introduction to freshwater biomonitoring and benthic macroinvertebrates. D.M. Rosenberg and V.H. Resh (eds.). Freshwater Biomonitoring and Benthic Macroinvertebrates. Chapman and Hall, New York, New York.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

Round, F.E. 1991. Diatoms in river water-monitoring studies. Journal of Applied Phycology 3:129-145.

Royer, T.V. and G.W. Minshall. 1996. Development of biomonitoring protocols for large rivers in Idaho: Annual Report 1996. Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello, Idaho.

Royer, T.V. and G.W. Minshall. 1997. Development of an index for the bioassessment of medium-sized rivers in Idaho and potential uses of ecosystem function in biomonitoring. Report to the Idaho Department of Environmental Quality. Stream Ecology Center, Department of Biological Sciences, Idaho State University, Pocatello, Idaho.

Royer, T.V. and G.W. Minshall. 1999. Bioassessment methods for Idaho Rivers: Validation and Summary, Final Report to the Idaho Department of Environmental Quality. Department of Biological Sciences, Idaho State University, Pocatello, Idaho.

Schuett-Hames, D., L. Bullchild, S. Hall, and A. Pleus. 1992. T-F-W ambient monitoring manual. Northwest Indian Fisheries Commission, Timber/Fish/ Wildlife Rep. TFW-AM9-92-002.

Scrivener, J.C., and M.J. Brownlee. 1989. Effects of forest harvesting on spawning gravel and incubation survival of Chum (Oncorhynchus keta) and Coho Salmon (O. kisutch) in Carnation Creek, British Columbia. Canada Journal Fisheries Aquatic Sciences. 46:681-698.

Shepard, B.B. 1983. Evaluation of a combined methodology for estimating fish abundance and lotic habitat in mountain streams of Idaho. Master's thesis. University of Idaho, Moscow.

Shepard, B.B., J.J. Fraley, T.M. Weaver, and P. Graham. 1982. Flathead River fisheries study 1982. Montana Department of Fish, Wildlife and Parks, Helena.

Simon, T.P. and J. Lyons. 1995. Application of the index of biotic integrity to evaluate water resource integrity in freshwater ecosystems, pp.245-262. Davis, W.S. and Simon, T.P. (eds.) Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. CRC Press, Inc., Boca Raton, Florida.

Sinokrot, B.A., and H.G. Stefan. 1994. Stream temperature dynamics: measurement and modeling. Water Resources Research 29(7): 2299-2312.

Skille, J. 1991. In-stream sediment and fish populations in the Little North Fork Clearwater River: Shoshone and Clearwater Counties, Idaho 1988-1990. Water Quality Summary Report No. 27, Division of Environmental Quality, Idaho Department of Health and Welfare, Coeur d' Alene.

Smith, K. 1981. The prediction of river water temperatures. Hydrological Sciences Bulletin 26:19-31.

Smith, K., and M.E. Lavis. 1975. Environmental influences on the temperature of a small upland stream. Oikos 26:228-236.

Stebbins, R.C. 1985. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston, MA. 336 pp.

Steed, R., and W.H. Clark. 1995. Idaho beneficial use reconnaissance project. 1995. Abstracts, 32nd Annual Meeting Idaho Chapter American Fisheries Society, Boise. 1 pp.

Stevens, H.H. Jr., et al. 1975. *Water Temperature-Influential Factors, Field Measurements, and Data Presentation*. Book 1, Chapter D1 Techniques of Water-Resources Investigations of the USGS. United States Geological Survey, Arlington, VA. 65p.

Stevenson, J.J. and M.B. Bain. 1999. Cover and refuge, pp. 105-113, *IN*: M.B. Bain and N.J. Stevenson (eds.) Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Stevenson, N.J. and K.E. Mills. 1999. Streambank and shoreline condition, pp. 115-124, *IN*: M.B. Bain and N.J. Stevenson (eds.) Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Thomas, A E. 2001. Amphibians of the eleven contiguous western states and Alaska. US Bureau of Land Management, Boise, ID. 156 pp.

Trimble. 1995. General reference for the GPS Pathfinder Professional System. Trimble Navigation, 585 N. Mary Ave. Sunnyvale, California. 131 p.

U.S. Bureau of Reclamation. 1974. Water measurement manual. U.S. Bureau of Reclamation. Denver, Colorado. 327 pp.

U.S. Fish and Wildlife Service. 2001. New Zealand mudsnail watch. U.S. Fish and Wildlife Service, Boise, ID. 4 pp.

U.S. Forest Service and U.S. Bureau of Land Management. 1995. (PACFISH) Decision Notice/Decision Record. Finding of no significant impact environmental assessment, for the interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California.

U.S. Geological Survey. 2000 (downloaded 2000). Geographic names information system (GNIS) Idaho. National Mapping Division, U.S. Geological Survey, Reston, VA. 479 pp. http://mapping/usgs/gov/pub/GNIS

Wilson, L.O. 1975. Distribution, season of use, and habitat of the mammals, birds, reptiles, amphibians, and fishes of Idaho. Bureau of Land Management, Boise. 132 pp.

Wilde, F.D., D.B. Radtke, J. Gibs, and R.T. Iwatsubo. 1998. Preparations for water sampling, Chapter A1, 41 pp. *IN*: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources, Section A. National Field Manual for the Collection of Water-Quality data. U.S. Geological Survey, Reston, Virginia.

Wolman, M.G. 1954. A method of sampling coarse river-bed material. Transaction of American Geophysical Union. 35:951-956.

Young, M.K., W.A. Hubert and T.A. Wasche. 1991. Selection of measures of substrate composition to estimate survival to emergence of Salmonids and to detect changes in stream substrates. North American Journal of Fisheries Management. 11(3):339-346.

Zaroban, Donald W. 2000. Protocol for Placement and Retrieval of Temperature Data Loggers in Idaho Streams. 34 pp.

8 Glossary

See the *Glossary of Aquatic Habitat Inventory Terminology* (Armantrout 1998) for a more complete glossary of aquatic habitat inventory terminology.

alluvial – related to material deposited by running water.

anode - the positive electrode.

anthropogenic-resulting from the influence of human beings on nature.

aquatic - pertaining to water; in this context, usually refers to plants or animal life living in, growing in, or adapted to water.

attainable use - a beneficial use that, with improvement, a waterbody could support in the future.

backwater pool – a pool caused by an eddy along the channel margin or by back-flooding upstream from an obstruction such as large woody debris, boulders or root wads.

bankfull depth – depth of water measured from the surface to the channel bottom when the water surface is even with the top of the streambank.

bank stability – the resistance of a bank to erosion.

beneficial use - any of the various uses that may be made of water, including, but not limited to, water supply (agricultural, domestic, or industrial), recreation in or on the water, aquatic biota, wildlife habitat, and aesthetics.

benthic zone – the bottom or bed of a water body.

canopy closure – the percentage of ground or water covered by shade from the outermost perimeter or natural spread of foliage from plants.

cascade – a highly turbulent series of short falls and small scour basins, with very rapid water movement as it passes over a steep channel bottom with gradients exceeding 8%.

cathode – the negative electrode.

chute – a narrow, confined channel through which water flows rapidly and smoothly; chutes are a class of runs.

conductivity – a measure of the ability of an aqueous solution to carry an electric current.

corner pool – see **meander pool.**

criteria - either a narrative or numerical statement of water quality on which to base judgement of suitability for beneficial use.

dammed pool – impoundment upstream of a complete or nearly complete channel blockage.

density – mass per unit volume.

designated use – a beneficial use listed for a waterbody or waterbodies in a state's water quality regulations.

discharge - commonly referred to as flow, expressed as volume of fluid per unit time (e.g. cubic feet per second) passing a particular point, in a river or channel or from a pipe.

eddy – a pool on the margin or off the main channel of a stream that is formed and maintained by strong eddy currents.

electrofishing – The use of electricity to provide a sufficient electrical stimulus in fish to permit easy capture by netting.

existing use - a beneficial use actually attained by a waterbody on or after November 28, 1975.

eutrophication - the process of nutrient enrichment in aquatic systems, such that the productivity of the system is no longer limited by the availability of nutrients. This is a natural process but may be accelerated by human activities.

***Escherichia coli* -** This bacteria, often referred to simply as *E. coli*, is found in the normal intestinal flora of warm-blooded animals. It is pathogenic and its presence in water indicates that the water has been in contact with or contaminated by fecal material.

floodplain – land beyond a stream channel that forms the perimeter for the maximum probability flood.

fluvial – pertaining to or living in streams or rivers, or produced by the action of flowing water.

formalin – a 37 percent by weight aqueous solution of formaldehyde with some methanol.

glide – a portion of the stream with slow-moving, relatively shallow water. The water surface has little or no turbulence, and the stream bottom is flat or slightly convex in shape, lacking the scour associated with the pool.

grab sample – a single sample collected at a particular time and place.

habitat – the place where a population lives, and its living and non-living surroundings.

high gradient riffle – a collective term for rapids and cascades.

HUC – a watershed numbering system developed by the U.S. Geological Survey.

integrity – the extent to which all parts or elements of a system (e.g. aquatic ecosystem) are present and functioning.

interrupted flow – water flowing alternately on the channel surface in some stream reaches and disappearing underground in others.

laminar flow – uniform streamflow with no mixing or turbulence.

lateral scour pool – a pool that forms around local obstructions such as boulders or individual logs.

low gradient riffle – shallow reaches with swiftly flowing turbulent water with some partially exposed substrate, usually cobble or gravel.

macroinvertebrate – an invertebrate (without backbone) animal, large enough to be seen without magnification and retained by a 0.6mm screen.

meander pool – a pool resulting from a shift in the channel direction (meander) and found along the outer curves of the channel, where scouring occurs.

monitoring - to check or measure water quality (chemical, physical, or biological) for a specific purpose, such as attainment of beneficial uses.

nonpoint source - referring to pollution originating over a wide geographical area, not discharged from one specific location.

organic – materials resulting from vegetative growth, decay, and accumulation in closed basins or on gentle slopes where the rate of accumulation exceeds that of decay.

organism – any living thing composed of one or more cells.

periphyton - a term for benthic algae, which is commonly used to refer to all of the microflora on substrata.

phreatohpyte – a plant whose roots generally extend downward to the water table; phreatophytes are common in riparian habitats.

plunge pool – a pool created by water passing over or through a complete or nearly complete channel obstruction, and dropping steeply into the streambed below scouring out a basin in the stream substrate where the flow radiates from the point of water entry.

point source – any discernable, confined, or discrete conveyance of pollutant, such as a pipe, ditch, or conduit.

pollution – any alteration in the character or quality of the environment due to human activity that makes it unfit or less suited for beneficial uses.

pool – an aquatic habitat in a stream with a gradient less than 1% that is normally deeper and wider than aquatic habitats immediately above and below it.

protocol – a collection of methods.

quality assurance – (QA) A program organized and designed to provide accurate and precise results. Examples include selection of proper technical methods, evaluation of data, quality control, and training of personnel. Its goal is to assure the data provided are of the quality needed and claimed.

quality control – (QC) Routine application of specific actions providing information for the quality assurance program. Examples include standardization, calibration and replication.

rapids – a moderately steep stream area with supercritical flow between 15 and 50%, rapid and turbulent water movement, surface with intermittent whitewater with breaking waves, coarse substrate, with exposed boulders at low flows, and a somewhat planar longitudinal profile.

reach – a relatively homogeneous stretch of a stream having a repetitious sequence of physical characteristics and habitat types; any specified length of a stream.

reconnaissance – an exploratory or preliminary survey of an area.

representativeness – the measure of the degree to which data accurately and precisely represent a characteristic of a population or environmental condition.

least impacted (reference) conditions – conditions which fully support applicable beneficial uses, with little impact from human activity and representing the highest level of support attainable.

riparian zone – natural home for plants and animals occurring in a thin strip of land bordering a stream or river; dominant vegetation often consists of phreatophytes.

riffle – a shallow reach with low subcritical flow in alluvial channels of finer particles that are unstable, characterized by small hydraulic jumps over rough bed material, causing small ripples, waves, and eddies, without breaking the surface tension.

riffle crest – the shallowest continuous line (usually not straight) across the channel close to where a water surface becomes continuously riffled.

river – the larger of BURP's two size designations for flowing water

run – a portion of the stream with swiftly flowing, relatively deep water, which approximates uniform flow. There are no major flow obstructions and little or no surface turbulence.

sample – a set of units or elements selected from a larger population, typically to be observed for making inferences regarding that population.

scour pool – a pool created by the scouring action of current flowing against an obstruction, causing an increase in lift and drag forces; a result of flow deflection, constriction, or increased local turbulence induced by a nonalluvial obstruction.

sediment – fine fragmented materials from weathered rocks and organic material that are suspended in, transported by, and eventually deposited by water or air.

sinuosity – the ratio of channel length between two points in a channel to the straight line distance between the same two points. Channels with sinuosities of 1.5 or more are called "meandering", while those close to 1.0 are called "straight".

stratification – the arrangement of water masses into distinct, horizontal layers that are separated by differences in density associated with water temperature and dissolved or suspended matter.

stream – a natural water course containing flowing water, at least part of the year, together with dissolved and suspended materials, that normally supports communities of plants and animals within the channel and the riparian vegetation zone.

stream order – hierarchical ordering of streams based upon the degree of branching. By the Strahler (1957) method, a first-order stream is an unforked or unbranching stream. Two first-order streams flow together to form a second-order stream, two second-order streams combine to make a third-order stream etc.

streambank – ground bordering a channel above the streambed and below the level of rooted vegetation that often has a gradient steeper than 45^{o} and exhibits a distinct break in slope from the stream bottom.

streambed - substrate plane, bounded by banks, of a stream bottom.

stream channel – a long, narrow depression shaped by the concentrated flow of a stream and covered continuously or periodically by water. Also, bed and banks formed by fluvial processes where a natural stream of water runs continually or intermittently.

stream classification – systems used to group or identify streams possessing similar features using geomorphic structure, water source, associated biota, or other characteristics.

streamflow – flow of water, generally with its suspended load, in a well-defined channel or water course.

substrate – mineral and organic material forming the bottom of a waterway or water body.

surface water – the collection of all natural bodies of water, including but not limited to streams, lakes, and wetlands, evident on the surface of the land.

targeted survey – the use of best professional judgement to choose sampling locations.

thalweg – a line joining the deepest points along successive cross-sections of a river channel.

trench pool – a pool that forms in a slot-like depression, usually found in bedrock channels; trench pools typically have long linear shapes.

turbidity – the reduction of transparency in water due to the presence of suspended particles.

turbulence – streamflows in which the velocity at a given point varies erratically in magnitude and direction and disrupts reaches with laminar flow.

waterbody – a specific body of water or geographically delimited portion thereof.

water quality – a term for the combined chemical, physical, and biological characteristics of water which affect its suitability for beneficial use.

wastewater - treated or untreated sewage, industrial waste, or agricultural waste and associated solids.

watershed – region or area drained by surface and groundwater flow in rivers, streams, or other surface channels. Also, the divide between two catchment (drainage) areas.

wetted width – the width of a water surface measured perpendicular to the direction of flow at a specific discharge.

width:depth ratio (W/D) – an index of the cross section shape of a stream channel, at bank-full level.

9 Index of Monitoring Variables

Acknowledgements

The Beneficial Use Reconnaissance Program Field Manual has evolved since 1993 into its present form. Many people have contributed to the effort in the past.
This field manual was assembled with the assistance of the Beneficial Use Reconnaissance Program Technical Advisory Committee (Sean Woodhead, William H. Clark, Dave Hull, Angie Petersen, Glen Pettit, Cynthia Grafe, Steve Robinson and Daniel Stewart). Valuable review and comments were received from Barry Burnell, Michael McIntyre, Cynthia Barrett, Darren Brandt, Dr. Sonny Buhidar and Don Zaroban. Technical peer review was provided by Bob Steed and technical editing by Lisa Hansen.

Appendix A

Sample Letter of Invitation to an Aquatic Monitoring Coordination Meeting

To Whom It May Concern:

The Idaho Department of Environmental Quality invites you to attend the 2002 Interagency Monitoring Coordination workshop. This once-a-year opportunity will allow you to network, exchange ideas, coordinate monitoring and become aware of the aquatic activities and/or monitoring proposed for this year in your areas of interest. Topics will revolve primarily around aquatic monitoring and restoration activities. Meeting attendees include representatives from private, local, state, and federal agencies.

If you plan to attend, please be prepared to give a brief overview of your aquatic monitoring/restoration activities this year and information detailing specific monitoring activities and locations. If you do not plan to attend, please send information indicating the type of monitoring you will be doing this year, location of this monitoring, and a contact name. In addition, please review the attached mailing list and provide me with any other pertinent contact names. We wish to insure this group is aware of all monitoring occurring within the basin.

Also, if you have any summaries from last year's efforts, please bring them as well. Attached is a proposed agenda for the meeting and mailing list. It is flexible so we can add more presenters if necessary.

This year's meeting will be held on (insert your date) at the DEQ Office, (insert your location). We will begin promptly at (insert the starting and ending times of the meeting). If you have any questions or suggestions, please contact me.

Sincerely,

(Name)

BURP Coordinator

DEQ (Address)

Phone: (208) (Phone Number)

email: (email address)

Appendix B

Informative Flyer About BURP Monitoring Activities

BENEFICIAL USE RECONNAISSANCE PROGRAM (BURP)

The Department of Environmental Quality (DEQ) **Beneficial Use Reconnaissance Program (BURP)** crews gather data from stream monitoring and from outside agencies to determine water quality conditions of Idaho streams.

There is one crew based in each of DEQ's six regional offices.

The crews:

- Work outdoors, camping and hiking to monitoring sites
- Monitor water quality
- Collect fish and aquatic insects
- Perform stream bank surveys

DEQ tries to monitor the quality of the waters in all
oring
act
perty if
URP
tural
t all

For more information, contact

The Department of Environmental Quality
1410N. Hilton, Boise, ID 83706
(208) 373-0502

Appendix C

Field Equipment Checklist

Field Equipment Checklist

MACROINVERTEBRATE SAMPLE EQUIPMENT	Yes	No
Hess and Surber Samplers (500 µm mesh w/300 ml bucket)		
White pans		
Macro sample containers		
Preservative (95% ethanol)		
Spare nets for Samplers		
Scrub brush		
(wash) bottles for rinsing (water and alcohol)		
Field labels		
Field Data Forms		
Rubber gloves		
Flexible forceps (larval)		
Pencils/Indelible alcohol proof markers		

PERIPHYTON SAMPLING EQUIPMENT	Yes	No
Periphyton sampler		
Periphyton brush		
Pipette		
10% formalin solution & dropper		
Labels		

WOLMAN PEBBLE COUNT EQUIPMENT	Yes	No
Metric ruler (clear plastic) or angled measuring device listed in Protocol #2		
Shoulder-length gloves		
Pencils/pens		
Field data sheets		
ELECTROFISHING EQUIPMENT	Yes	No
Collecting Permits or IDFG personnel		
Electrofisher		
Anode and Cathode		
Dip nets		
Waders (non breathable, non conductive material)		
Rubber gloves (shoulder-length)		
Specific Conductivity Meter		
Preservative: 10% buffered formalin solution		
Thermometer		
Small aquarium nets		
Anesthetic		
Buckets		
Gas/oil and spare spark plugs (if using gas-powered electrofisher)		
Generator (if using a battery-powered electrofisher) and spare parts		
Spare fuses		
Specimen vouchering containers		

Fish measuring board		
Fish identification keys		
Clipboard/notebook/fish labels		
Field data sheets		
First Aid Kit		
Polarized sunglasses		
Fire extinguisher		

FLOW MEASUREMENT EQUIPMENT	Yes	No
Current velocity meter		
Top-setting-wading rod		
100 m measuring tape (minimum length)		
Rebar stakes		
Flow sheets		
Pencils/clipboard		
Waders		
Extra batteries for current meter		

BACTERIA SAMPLING EQUIPMENT	Yes	No
Bacteria check sheet		
Sterilized bacteria sample bottles		
Labels/label tape		
Indelible marker		
Cooler with ice		

MISCELLANEOUS EQUIPMENT	Yes	No
First Aid Kit		
Sunscreen		
Emergency equipment for vehicle		
GPS receiver		
Tool Kit		
Clinometer		

Densiometer		
2 meter rod		
Tape measures		
Random number table		
Field notebook/clipboards		
Maps		
"All" forms and labels		
Camera & film		
Extra batteries		
Current BURP Field Manual and Workplan		
IDEQ/Other Protocols		
Pens/pencils		
Duct Tape		
String		
Flagging		

Appendix D

Material Safety Data Sheets (MSDS)

001 03/30/99 ETHANOL RED BAND III 190 PROOF

Section 1. Chemical Product

Product Name:	Ethanol Red Band III 190 proof
MSDS #:	CM0287
Date Issued:	3/29/99
Supersedes:	New
Issued By:	000099
Synonym:	Not available.
Trade Names:	Not available.
Material Uses:	Not available.

Section 2. Composition and Information in Ingredients

NAME	CAS #	% BY Weight	EXPOSURE LIMITS
Ethanol	64-17-5	90-95	TWA: 1880 (mg/m3) from ACGIH (TLV) TWA: 1000 (ppm) from ACGIH (TLV) TWA: 1900 (mg/m3) from OSHA TWA: 1000 (ppm) from OSHA
Water	7732-18-5	5	Not available.
Methyl alcohol	67-56-1	3-4	TWA: 262 STEL: 328 (mg/m3) from ACGIH (TLV) TWA: 200 STEL: 250 (ppm) from ACGIH (TLV) SKIN TWA: 260 STEL: 328 (mg/m3) from OSHA TWA: 200 STEL: 328 (ppm) from OSHA
Ethyl acetate	141-78-6	0-2	TWA: 1440 (mg/m3) from ACGIH (TLV) TWA: 400 (ppm) from ACGIH (TLV) TWA: 1400 (mg/m3) from OSHA TWA: 400 (ppm) from OSHA
Methyl isobutyl ketone	108-10-1	0-2	TWA: 205 STEL: 307 (mg/m3) from ACGIH (TLV) TWA: 50 STEL: 75 CEIL: 125 (ppm) from ACGIH (TLV) TWA: 410 STEL: 307 CEIL: 510 (mg/m3) from OSHA TWA: 100 STEL: 75 (ppm) from OSHA
Light aliphatic solvent naphtha (petroleum)	64742-89-8	0-2	Not available.

Ingredients not precisely identified are proprietary or nonhazardous under Federal Hazard Communication Standards (29 CFR 1910.1200).

Section 3. Hazards Identification
Physical State and Appearance - Liquid.

Emergency Overview
WARNING!
Keep away from heat, sparks and flame. Avoid contact with eyes. Avoid breathing vapors or spray mists.
Avoid contact with skin and clothing. Keep container closed. Use only with adequate ventilation. Wash
thoroughly after handling.

Routes of Entry
Dermal contact. Eye contact. Inhalation. Ingestion.
Potential Acute Health Effects
Eyes
Hazardous in case of eye contact (irritant).
Skin
Sensitization of the product: Not available.
Very hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact
(permeator). Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.
Inhalation
Slightly hazardous in case of inhalation.
Ingestion
Slightly hazardous in case of ingestion.
Potential Chronic Health Effects
CARCINOGENIC EFFECTS: Classified A4 (Not classifiable for human or animal.) by ACGIH (Ethanol). Classified A4 (Not classifiable for human or animal.) by ACGIH (Ethyl acetate).
MUTAGENIC EFFECTS: Not available.
TERATEGENIC EFFECTS: Not available.
Medical Conditions Aggravated by Overexposure:
Repeated or prolonged exposure is not known to aggravate medical condition.
Overexposure/Signs/Symptoms - Not available.
See Toxicological Information (Section 11)

Section 4. First Aid Measures
Eye Contact
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.
Skin Contact
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds,

crevices, creases and groin. Cold water may be used. Cover the irritated skin with an emollient. If irritation
persists, seek medical attention. Wash contaminated clothing before reusing.

Hazardous Skin Contact

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation

Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Hazardous Inhalation

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion

Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Hazardous Ingestion - Not Available.

Notes to Physician - Not available.

Section 5. Fire Fighting Measures

Flammability of the Product
Flammable.
Auto-ignition Temperature
The lowest known value is 363 deg C (685.4 deg F) (Ethanol).
Flash Points
The lowest known value is CLOSED CUP: -4.4 deg C (24.1 deg F).
OPEN CUP: -4 deg C (24.8 deg F). (Cleveland). (Ethyl acetate)
Flammable Limits
The greatest known range is LOWER: 6% UPPER: 36.5%
(Methyl alcohol)
Products of Combustion
These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances
Flammable in presence of open flames and sparks, of heat, of combustible materials.
Slightly flammable to flammable in presence of oxidizing materials.
Explosion Hazards in Presence of Various substances
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog.
Protective Clothing (Fire)
Be sure to use an approved/certified respirator or equivalent.
Special Remarks on Fire Hazards

Containers should be grounded. (Ethanol)
Special Remarks on Explosion Hazards - Not available.

Section 6. Accidental Release Measures
Small Spill
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.
Large Spill
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed.
Eliminate all ignition sources. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7. Handling and Storage
Handling
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/vapor/spray. Wear suitable protective clothing. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.
Storage
No specific storage is required. Use shelves or cabinets sturdy enough to bear the weight of the chemicals. Be sure that it is not necessary to strain to reach materials, and that shelves are not overloaded.

Section 8. Exposure Controls/Personal Protection
Engineering Controls
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection
Eyes - Splash goggles.
Body - Lab coat.
Respiratory - Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Hands - Gloves.
Feet -Not applicable.
Personal Protection in Case of a Large Spill
Splash goggles. Full suit. Vapor respirator. Boots.
Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product.
Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Chemical Name or Product Name	Exposure Limits
Ethanol	**TWA: 1880 (mg/m3) from ACGIH (TLV)**
	TWA: 1000 (ppm) from ACGIH (TLV)
	TWA: 1900 (mg/m3) from OSHA

	TWA: 1000 (ppm) from OSHA
Methanol	TWA: 262 STEL: 328 (mg/m3) from ACGIH (TLV)
	TWA: 200 STEL: 250 (ppm) from ACGIH (TLV)
SKIN	
	TWA: 260 STEL: 328 (mg/m3) from OSHA
	TWA: 200 STEL: 328 (ppm) from OSHA
Ethyl acetate	TWA: 1440 (mg/m3) from ACGIH (TLV)
	TWA: 400 (ppm) from ACGIH (TLV)
	TWA: 1400 (mg/m3) from OSHA
	TWA: 400 (ppm) from OSHA
Methyl isobutyl ketone	TWA: 205 STEL: 307 (mg/m3) from ACGIH (TLV)
	TWA: 50 STEL: 75 CEIL: 125 (ppm) from ACGIH (TLV)
	TWA: 410 STEL: 307 CEIL: 510 (mg/m3) from
OSHA	
	TWA: 100 STEL: 75 (ppm) from OSHA
Light aliphatic solvent naphtha (petroleum)	Not available.

Consult local authorities for acceptable exposure limits.

Section 9. Physical and Chemical Properties

Physical State and Appearance
Liquid - Boiling/Condensation Point
The lowest known value is 64.7 deg C (148.5 deg F) (Methyl alcohol). Weighted average: 79.34 deg C (174.8 deg F)
Melting/Freezing Point
May start to solidify at 0 deg C (32 deg F) based on data for:
Water. Weighted average: -107.43 deg C (-161.4 deg F)
Color - Not available.
Specific Gravity - Weighted average: 0/8 (Water = 1)
Vapor Pressure - The highest known value is 97.68 mm of Hg (at 20 deg C) (Methyl alcohol).
Weighted average: 42.15 mm of Hg (at 20 deg C)
Vapor Density
The highest known value is 3.45 (Air = 1) (Methyl isobutyl ketone). Weighted average: 1.62 (Air = 1)
Volatility
Odor Threshold
The highest known value is 180 ppm (Ethanol) Weighted average: 175.8 ppm
Evaporation Rate
The highest known value is 3.3 (Ethanol) Weighted average: 3.28 compared to Butyl acetate.
VOC
Viscosity -Not available
Solubility
Easily soluble in cold water, hot water, methanol, diethyl ether.
pH (1% Soln/Water)
Neutral.
Odor -Not available.
Taste -Not available.
Physical Chemical Comments -Not available.

Section 10. Stability and Reactivity
Stability and Reactivity
The product is stable.
Conditions of Instability - Not available.
Incompatibility with Various Substances
Reactive with oxidizing agents.
Non-reactive with acids, alkalis.
Hazardous Decomposition Products - Not available.
Hazardous Polymerization - Not available.

Section 11. Toxicological Information
Toxicity to Animals
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 2080 mg/kg (Rat).
(Methyl isobutyl ketone).
Acute dermal toxicity (LD50): 15800 mg/kg (Rabbit.).
(Methyl alcohol).Acute toxicity of the vapor (LC50): 8000 ppm 4 hour(s) (Rat.). (Ethanol).
Chronic Effects on Humans
CARCINOGENIC EFFECTS: Classified A4 (Not classifiable for human or animal.) by ACGIH (Ethanol). Classified A4 (Not classifiable for human or animal.) by ACGIH (Ethyl acetate).
DEVELOPMENTAL TOXICITY: PROVEN (Ethanol)
The substance is toxic to blood, the nervous system, the reproductive system, liver, upper respiratory tract, skin, eyes, respiratory tract, gastrointestinal tract, kidneys.
Other Toxic Effects on Humans
Very hazardous in case of skin contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
Special Remarks on Toxicity to Animals - Not available.
Special Remarks on Chronic Effects on Humans
0040 Passes through the placental barrier.
May be fatal or cause blindness if swallowed. (Methyl alcohol)
Special Remarks on Other Toxic Effects on Humans
Moderately toxic and narcotic in high concentrations.
Experimentally tumorigen. (Ethanol)

Section 12. Ecological Information
Ecotoxicity - Not available.
BOD5 and COD - Not available.
Biodegradable/OECD - Not available
Mobility - Not available.
Toxicity of the Products of Biodegradation
Possibly hazardous short term degradation products are not likely.
However, long term degradation products may arise.
The products of degradation are less toxic than the product itself.
Special Remarks on the Products of Biodegradation - Not available.

Section 13. Disposal Considerations

Waste Information - Not available.
Waste Stream - Not available.
Consult an expert on disposal of waste and material used in spill cleanup and ensure conformity to all federal, state and local disposal regulations. Regulatory requirements are subject to change and may differ from one location to another; the generator of the waste is responsible for proper waste disposal.

Section 14. Transport Information
DOT Classification
Class 3: Flammable liquid.
Ethanol, Solution UN1170 II

Marine Pollutant - Not available.
Hazardous Substances Reportable Quantity (Kg) - Not available.

Special Provisions for Transport - Not available.

Section 15. Regulatory Information
U.S. Federal Regulations
SARA 302/304 Emergency planning and notification:
No products were found.

CERCLA: Hazardous substances: Methyl alcohol: 5000 lbs. (2268 kg); Ethyl acetate: 5000 lbs. (2268 kg); Methyl isobutyl ketone: 5000 lbs. (2268 kg);

SARA 313 toxic chemical notification and release reporting: Methyl alcohol: 1%; Methyl isobutyl ketone: 1%.

TSCA 5 (e) substance consent order: Ethyl acetate; Methyl isobutyl ketone
TSCA 8 (a) PAIR: Methyl isobutyl ketone
TSCA 8 (a) IUR: Ethyl acetate; Methyl isobutyl ketone
TSCA 8 (b) inventory: Ethanol; Water; Mthyl alcohol; Ethyl acetate; Methyl isobutyl ketone; Light aliphatic solvent naphtha (petroleum)
TSCA 12 (b) one time export: Ethyl acetate; Methyl isobutyl ketone

SARA 311/312 MSDS distribution – chemical inventory – hazard identification: Ethanol: fire, immediate health hazard, delayed health hazard; Methyl alcohol: fire, immediate health hazard, delayed health hazard; Ethyl acetate: fire, immediate health hazard; Methyl isobutyl ketone: fire, reactive, immediate health hazard; Light aliphatic solvent naphtha (petroleum): fire, immediate health hazard

State Regulations
Rhode Island RTK hazardous substances: Ethanol; Methyl alcohol; Ethyl acetate; Methyl isobutyl ketone
Pennsylvania RTK: Ethanol, Methyl alcohol: (environmental hazards); Ethyl acetate: (environmental hazard); Mthyl isobutyl ketone: (environmental hazard)
Florida: Ethanol; Methyl alcohol; Ethyl acetate; Methyl isobutyl ketone

Minnesota: Ethanol; Methyl alcohol; Ethyl acetate; Methyl isobutyl ketone
Massachusetts RTK: Ethanol; Methyl alcohol; Ethyl acetate; Methyl isobutyl ketone
New Jersey: Ethanol; Methyl alcohol; Ethyl acetate; Methyl isobutyl ketone
New Jersey spill list: Ethanol; Methyl alcohol; Ethyl acetate; Methyl isobutyl ketone

California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Ethanol

Section 16. Other Information

National Fire Protection Association (U.S.A.)

Health 1

Flammability 3

Reactivity 0

Specific

Hazard

Other Special Considerations - Not available.

This mixture has not been tested as a whole, the data presented is based on the properties of the individual components.

----------NOTICE----------

** VAN WATERS & ROGERS INC. (“VW&R”) EXPRESSLY DISCLAIMS ALL EXPRESS OR

IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE,

WITH RESPECT TO THE PRODUCT OR INFORMATION PROVIDED HEREIN, AND SHALL UNDER

NO CIRCUMSTANCES BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.**

ALL INFORMATION APPEARING HEREIN IS BASED UPON DATA OBTAINED FROM THE MANUFACTURER AND/OR RECOGNIZED TECHNICAL SOURCES. WHILE THE INFORMATION IS BELIEVED TO BE ACCURATE, VW&R MAKES NO REPRESENTATIONS AS TO ITS ACCURACY OR SUFFICIENCY. CONDITIONS OF USE ARE BEYOND VW&RS CONTROL AND THEREFORE USERS ARE RESPONSIBLE TO VERIFY THIS DATA UNDER THEIR OWN OPERATING CONDITIONS TO DETERMINE WHETHER THE PRODUCT IS SUITABLE FOR THEIR PARTICULAR PURPOSES AND THEY ASSUME ALL RISKS OF THEIR USE, HANDLING, AND DISPOSAL OF THE PRODUCT, OR FROM THE PUBLICATION OR USE OF, OR RELIANCE UPON, INFORMATION CONTAINED HEREIN. THIS INFORMATION RELATES ONLY TO THE PRODUCT DESIGNATED HEREIN, AND DOES NOT RELATE TO ITS USE IN COMBINATION WITH ANY OTHER MATERIAL OR IN ANY OTHER PROCESS.

* * * E N D OF M S D S * * *

MSDS

24 Hour Emergency Telephone: 908-859-2151

CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
From: Mallinckrodt Baker, Inc.
222 Red School Lane Outside U.S. and Canada
Phillipsburg, NJ 08865 Chemtrec: 202-483-7616

MALLINCKRODT

NOTE CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

FORMALDEHYDE SOLUTION, BUFFERED 10%

1. Product Identification

Synonyms: Formaldehyde solution, buffered, 10% (v/v) in aqueous phosphate buffer

CAS No: Not applicable to mixtures.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: HCHO and CH_3OH in water.
Product Codes: H121

2. Composition/Information on Ingredients

Ingredient	CAS No.	Percent	Hazardous
Methyl Alcohol	67-56-1	1 – 1.5%	Yes
Formaldehyde	50-00-0	4%	Yes
Water	7732-18-5	-95%	No

DANGER! MAY BE FATAL IF SWALLOWED HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT STRONG SENSITIZER MAY CAUSE BLINDNESS, COMBUSTIBLE LIQUID AND VAPOR. SUSPECT CANCER HAZARD CONTAINS FORMALDEHYDE WHICH MAY CAUSE CANCER. Risk of cancer depends upon duration and level of exposure.

3. Hazards Identification

Emergency Overview

Potential Health Effects

The perception of formaldehyde by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This can lead to overexposure if a worker is relying on formaldehyde's warning properties to alert him or her to the potential for exposure.

Inhalation:

May cause sore throat, coughing, and shortness of breath. Causes irritation and sensitization of the respiratory tract. Concentrations of 25 to 30 ppm cause severe respiratory tract injury leading to pulmonary edema and pneumonitis. May be fatal in high concentrations.

Ingestion:

Can cause severe abdominal pain, violent vomiting, headache, and diarrhea. Larger does may produce decreased body temperature, pain in the digestive tract, shallow respiration, weak irregular pulse,

unconsciousness and death. Methanol component affects the optic nerve and may cause blindness.

Skin Contact:

Toxic. May cause irritation to skin with redness, pain, and possibly burns. Skin absorption may occur with symptoms paralleling those from ingestion. Formaldehyde is a severe skin irritant and sensitizer. Contact causes white discoloration, smarting, cracking and scaling.

Eye Contact:

Vapors cause irritation to the eyes with redness, pain, and blurred vision. Higher concentrations or splashes may cause irreversible eye damage.

Chronic Exposure:

Frequent or prolonged exposure to formaldehyde may cause hypersensitivity leading to contact dermatitis. Repeated or prolonged skin contact with formaldehyde may cause an allergic reaction in some people. Vision impairment and enlargement of liver may occur from methanol component. Formaldehyde is a suspected carcinogen (positive animal inhalation studies).

Aggravation of Pre-existing Conditions:

Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance. Previously exposed persons may have an allergic reaction to future exposures.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:

If swallowed and the victim is conscious, dilute, inactivate, or absorb the ingested formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate formaldehyde. Keep affected person warm and at rest. Get medical attention immediately. If vomiting occurs, keep head lower than hips.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:

Monitor arterial blood gases and methanol levels after significant ingestion. Hemodyalysis may be effective in formaldehyde removal. Use formic acid in urine and formaldehyde in blood or expired air as diagnostic tests.

5. Fire Fighting Measures

Fire:

Flash point: 85° C (185°F) cc

Combustible liquid and vapor! Gas vaporizes from solution and is flammable in air.

Explosion:

Above the flash point, explosive vapor-air mixtures may be formed. Containers may explode when involved in a fire.

Fire Extinguishing Media:

Water spray, dry chemical, alcohol foam, or carbon dioxide.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

Water spray may be used to keep fire exposed containers cool. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e.g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Store in a tightly closed container. Protect against physical damage. Outside or detached storage is preferred. Inside storage should be in a standards flammable liquids storage room or cabinet. Separate from oxidizing materials. Storage and use areas should be No Smoking areas. Wear special protective equipment (Sec. 8) for maintenance break-in or where exposures may exceed established exposure levels. Wash hands, face, forearms and neck when exiting restricted areas. Shower, dispose of outer clothing, change to clean garments at the end of the day. Avoid cross-contamination of street clothes. Wash hands before eating and do not eat, drink, or smoke in workplace. Protect from freezing. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL):

0.75 ppm (TWA), 2ppm (STEL), 0.5 ppm (TWA) action level for formaldehyde

200 ppm (TWA) for methanol

-ACGIH Threshold Limit Value (TLV):

0.3 ppm Ceiling formaldehyde, A2 Suspected Human Carcinogen

200 ppm (TWA) 250 ppm (STEL) skin for methanol

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control

the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirator (NIOSH Approved)

If the exposure limit is exceeded, a full facepiece respirator with a formaldehyde cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres. Irritation also provides warning. For Methanol: If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Other Control Measures:

See OSHA Standard for more information on personal protective equipment, engineering and work practice controls, medical surveillance, record keeping, and reporting requirements. (29 CFR 1910.1048)

9. Physical and Chemical Properties

Appearance: Clear, colorless solution. Boiling Point: ~100°C (~212°F)

Odor: Slight pungent odor. Melting Point: ~0°C (~32°F)

Solubility: Soluble in water. Vapor Density (Air=1):

Specific Gravity: ~1.0 Essentially the same as water.

pH: No information found. Vapor Pressure (mm Hg):

% Volatiles by volume @ 21°C (70°F): Essentially the same as water.

100 Evaporation Rate (BuAc=1): Essentially the same as water.

10. Stability and Reactivity

Stability: Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.

Hazardous Polymerization: Will not occur

Incompatabilities:

Incompatible with oxidizing agents and alkalis. Reacts explosively with nitrogen dioxide at –180° C (356° F). Reacts violently with perchloric acid, perchloric acid-aniline mixtures, and nitromethane. Reaction with hydrochloric acid may form bis-chloromethyl ether, and OSHA regulated carcinogen.

Conditions to Avoid: Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Formaldehyde: Oral rat LD50: 100 mg/kg; skin rabbit LD50: 270 uL/kg, Irritation data: eye, rabbit, 750ug Severe; inhalation rate LC50: 203 mg/m$^{3;}$ investigated as a tumorigen, mutagen, reproductive effector; Cancer Status: an OSHA regulated carcinogen. Methanol: oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; investigated

Cancer Lists

as a tumorigen, mutagen, reproductive effector.

-- NTP Carcinogen—

Ingredient	Known	Anticipated	IARC Category
Methyl Alcohol (67-56-1)	No	No	None
Formaldehyde (50-00-0)	No	Yes	2A
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:

The following statements refer to the environmental fate of formaldehyde. When released into the soil, this material is expected to leach into groundwater. When released into water, this material is expected to readily biodegrade. When released into water, this material is not expected to evaporate significantly. This material is not expected to significantly bioaccumulate.

When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to be readily degraded by photolysis. When released into the air, this material is expected to be readily removed from the atmosphere by dry and wet deposition. When released into the air, this material is expected to have a half-life of less than 1 day. The following statements refer to the environmental fate of methanol. When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material is expected to readily biodegrade. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition. When released into air, this material is expected to have a half-life between 10 and 30 days.

Environmental Toxicity:

The following toxicity information is for the formaldehyde portion. this material is expected to be slightly toxic to aquatic life. The LC5096-hour values for fish are between 10 and 100 mg/1. The methanol portion is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/1.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations.

Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

Chemical Inventory Status

					--Canada--			
Ingredient	TSCA	EC	Japan	Australia	Korea	DSL	NDSL	Phil.
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

Formaldehyde (50-00-0)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

Federal, State & International Regulations

	--SARA 302--		---------SARA 313-------		-RCRA--TSCA-		
Ingredient	RQ	TPQ	List	Chemical Catg.	CERCLA	261.33	8(d)
Methyl Alcohol (67-56-1)	No	No	Yes	No	5000	U154	No
Formaldehyde (50-00-0)	100	500	Yes	No	100	U122	No
Water (7732-18-5)	No	No	No	No	No	No	No

CHEMICAL WEAPONS CONVENTION: NO TSCA 12(B): NO CDTA: NO

SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No Reactivity: No (Mixture/Liquid)

Warning:

THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 2T Australian Poison Schedule: No information found.

WHMIS: This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 2 Reactivity: 0

Label Hazard Warnings:

DANGER! MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN, CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT, STRONG SENSITIZER, MAY CAUSE BLINDNESS, COMBUSTIBLE LIQUID AND

VAPOR. SUSPECT CANCER HAZARD. CONTAINS FORMALDEHYDE WHICH MAY CAUSE CANCER. Risk of cancer depends upon duration and level of exposure.

Label Precautions: Keep away from heat, sparks and flame. Do not breathe vapor. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Do not get in eyes, on skin, or on clothing. Physical and health hazard information is available from employer and from material safety data sheets.

Label First Aid: In all cases call a physician. If swallowed and the victim is conscious, dilute, inactivate, or absorb the ingested formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate formaldehyde. Keep affected person warm and at rest. If vomiting occurs, keep head lower than hips. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes.

Product Use: Laboratory Reagent.

Revision Information: MSDS Section(s) changed since last revision of document include: 3, 4, 16.

Disclaimer: Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS, ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OUR RELIANCE UPON THIS INFORMATION.

Prepared by: Strategic Services Division
Phone Number (314) 539-1600 (U.S.A.)

Appendix E

Formalin Health and Safety

FORMALIN HEALTH AND SAFETY

All field and laboratory activities will be performed in accordance with the Occupational Safety and Health Administrations' requirements for a safe work place. It is the responsibility of the participants to establish and implement the appropriate health and safety procedures for the work being performed. All field staff are expected to review and understand the Material Safety Data Sheet and the Chemical Fact Sheet for chemicals of concern provided by field staff supervisors. Field staff are instructed to immediately report to their supervisor the development of any adverse signs or symptoms that they suspect are attributable to chemical exposure.

The environmental samples scheduled to be collected during this Program will be obtained from surface water bodies located in natural settings. Samples to be collected include fish specimens and aquatic macroinvertebrates. The sample stations and samples to be collected are not considered to be hazardous; however, sample preservation materials include formalin (formaldehyde), which requires prudent safety precautions by those collecting samples and those coming into contact with or disposing of samples collected during this Program.

Hazardous Materials (Formaldehyde)

Commercial grade formalin contains 37 to 55 percent formaldehyde. The use of formaldehyde and its derivatives are regulated under 29 CFR 1910.1048. Formaldehyde is a suspected human carcinogen. Formaldehyde is highly flammable, and is incompatible with strong oxidizers, strong alkalies, acids, phenols, and urea.

Formaldehyde Exposure Limits

There may be no safe level of exposure to a carcinogen, so all contact with formalin should be reduced to the lowest possible level. The odor threshold of 0.83 parts per million (ppm) for formaldehyde serves only as a warning of exposure. The permissible exposure limit (PEL) for formaldehyde is 0.75 ppm averaged over an eight-hour work shift. The time-weighted average (TWA) for airborne concentrations of formaldehyde (STEL) is 2 ppm. The American Conference of Governmental Industrial Hygienist recommend airborne exposure limit to formaldehyde is not to exceed 0.3 ppm averaged over an eight-hour work period.

Respirators shall be used when 1) installing feasible engineering and work practice controls, 2) engineering and work practice controls are not feasible, and 3) engineering and work practice controls are not sufficient to reduce exposure to or below the Permissible Exposure Limit. Respirator use should be limited to an MSHA/NIOSH approved supplied air respirator with a full face piece operated in the positive mode or with a full face piece, hood, or helmet operated in the continuous flow mode. A MSHA/NIOSH approved self-contained breathing apparatus with a full-face piece operated in pressure demand or other positive mode is also recommended.

Formaldehyde exposure occurs through inhalation and absorption. Exposure irritates the eyes, nose, and throat, and can cause skin and lung allergies. Higher levels can cause throat spasms and a build-up of fluid in the lungs, cause for a medical emergency. Contact can cause severe eye and skin burns, leading to permanent damage. These may appear hours after exposure, even if no pain is felt.

Formaldehyde First Aid

If formaldehyde gets into the eyes, remove any contact lenses at once and irrigate immediately with deionized water, distilled water or saline solution. If formaldehyde contacts exposed skin, flush with water promptly. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once and perform artificial respiration, if needed. When formaldehyde has been swallowed, get medical attention. Give large quantities of water and induce vomiting. Do not make an unconscious person vomit.

Formaldehyde Fire and Explosion Hazard

Mixtures of air and free formaldehyde gas are highly flammable. Formalin is a combustible liquid, and presents a moderate fire and explosion hazard. Use a dry chemical, carbon dioxide, water spray, or "alcohol" form to extinguish formalin fires. Store formalin solutions in insulated, closed containers in a cool, dry, well-ventilated area separate from oxidizing agents and alkaline materials. Protect formalin containers from physical damage.

Formalin Spill Procedures

In case of a spill or leak, eliminate all sources of ignition, provide adequate ventilation, notify supervisor, and evacuate all nonessential personnel. Neutralize spilled formalin with aqueous ammonia or mix with sodium sulfite. Wash residues with diluted ammonia to eliminate vapor. Prevent runoff from entering streams, surface waters, waterways, watersheds, and sewers.

Formalin Work Area Controls

Work area locations at stream sampling stations will be selected to ensure adequate ventilation when sample container lids are removed. Work area locations will be located downwind from field crew activities, and will be isolated from field crew traffic. A single field crew member will be designated and authorized to secure the formaldehyde work area at sampling stations. This crew member will ensure proper handling of sample containers and fish specimens, and will be responsible for establishing proper precautions for minimizing field crew exposure to formaldehyde at sampling stations.

Formalin Work Area Practices

Formalin (formaldehyde) is being used in this protocol for the purpose of asphyxiation and preservation of fish specimens. Pre-labeled and pre-preserved plastic sample containers will be delivered to the field crew secured in large ice chests. Field crews will transport the containers in the coolers to the field sample stations. Fish specimens will be collected by hand and placed into the sample containers. Container lids will be removed immediately prior to, and closed immediately after fish specimens and specimen labels are placed into the sample container. Specimens will be placed into the sample container and minimize the amount of time the sample preservative is not contained. The sample container will be placed into a large plastic bag and secured in an ice cooler until delivered to the laboratory for analysis.

Formalin Personal Protection

Field crew members within the designated formalin work area at sample stations will wear a full face shield, impervious nitrile, butyl rubber, or viton gloves, boots and aprons, etc. to prevent excessive or prolonged skin contact. Contact lenses will not be worn within the designated formalin work area. No eating, drinking, or smoking will be allowed in the designated formalin work area.

Wash thoroughly after using formalin. Avoid transferring formalin from hands to mouth while eating, drinking, or smoking. Avoid direct contact with formalin. Remove contaminated clothing and launder before wearing. Contaminated work clothing should not be taken home. Contaminated work clothing should be laundered by individuals who have been informed of the hazards of exposure to formalin.

Appendix F

DEQ Flip Charts for

Riffle/Run Habitat Assessments

March 2003
H. S.

Habitat Assessment Data Sheet
RIFFLE/RUN PREVALENCE

Riffle & Run Habitats: areas of the stream with *faster* current and *shallower* depth; typically much of the water surface is visibly broken. Look for in Rosgen A-type channels, and streams with coarser substrate. Can have numerous pools.

2. *Instream Cover (fish):*

Greater than 50% mix of cobble, gravel, woody debris, undercut banks, or other stable fish cover.	30-50% mix of cobble, gravel, or other stable fish cover. Adequate cover.	10-30% mix of cobble, gravel, other stable fish cover. Cover availability is less than desirable.	Less than 10% cobble, gravel or other stable cover. Lack of cover is obvious.
16 – 20	11 – 15	6 – 10	0 – 5

3. *Embeddedness (riffles):*

Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment (particles less than 6.35mm)	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are >75% surrounded by fine sediment, or bottom is sand, clay or bedrock.
16 – 20	11 – 15	6 – 10	0 – 5

5. *Channel Shape (see overleaf for further guidance):*

Trapezoidal	Rectangular	Inverse Trapezoidal
11 – 15	6 – 10	0 – 5

10. *Disruptive Pressures (on streambank, immediately adjacent to stream):*

Vegetative disruption minimal or not evident. Almost all potential plant biomass at present stage of development remains.	Disruption evident but not affecting community vigor. Vegetative use is moderate, 60-90% of the potential plant biomass remains.	Disruption obvious; some patches of bare soil or closely cropped vegetation present. 30-60% of potential plant biomass remains.	Disruption of streambank vegetation is very high. Vegetation has been removed to less than 30% of the potential plant biomass.
9 – 10	6 – 8	3 – 5	0 – 2

11. *Zone of Influence (width of riparian vegetative zone):*

Width of riparian vegetative zone (on each side) is at least 4 times the width of the stream. Human activities have caused no impact at all.	Width of riparian vegetative zone (on each side) is at least twice the width of the stream. Human activities have caused minimal impact.	Width of riparian vegetative zone (each side) is at least as wide as the stream. Human activities have caused a great deal of impact.	Little or no riparian vegetation due to man induced activities (parking lots, clearcuts, lawns or crops planted to the edge of the stream).
9 – 10	6 – 8	3 – 5	0 – 2

Appendix G

DEQ Flip Chart for

Glide/Pool Habitat Assessments

Habitat Assessment Data Sheet
GLIDE/POOL PREVALENCE

Glide & Pool Habitats: **usually few riffles and slower water column velocity. Generally, but not always, deeper than riffle/run habitats. Look for in lower gradient stream segments; often seen in wide, flat valleys. Usually *depositional* in character. Number of pools can vary.**

1. *Pool Substrate Characteristic:*			
Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or submerged vegetation.
16 – 20	11 – 15	6 – 10	0 – 5

2. *Instream Cover (fish):*

See overleaf

3. *Pool Variability:*			
Even mix of deep, shallow, large and small pools.	Majority of pools large and deep. Very few shallow pools.	Shallow pools much more prevalent than deep pools.	Majority of pools small and shallow, or pools absent.
16 – 20	11 – 15	6 – 10	0 – 5

5. *Channel Shape:*

See overleaf

10. *Disruptive Pressures (on streambank, immediately adjacent to stream):*

See overleaf

11. *Zone of Influence (width of riparian vegetative zone, least buffered side):*

See overleaf

Channel Shape Guidance
(crew to make final determination, based on field observations)

Mean Bank Angle	**Predominant Wetted Channel Shape**	Score	Mean Bank Angle	**Predominant Wetted Channel Shape**	Score
0-10	Inverse Trapezoidal	1	81-90	Rectangular	9
11-20	Inverse Trapezoidal	2	91-100	Rectangular	10
21-30	Inverse Trapezoidal	3	101-110	Trapezoidal	11
31-40	Inverse Trapezoidal	4	111-120	Trapezoidal	12
41-50	Inverse Trapezoidal	5	121-130	Trapezoidal	13
51-60	Rectangular	6	131-140	Trapezoidal	14
61-70	Rectangular	7	> 140	Trapezoidal	15
71-80	Rectangular	8			

Appendix H

Electrofishing Safety Orientation and Acknowledgement

Electrofishing Safety Policy and Plan

1. **Purpose**
   The purpose is to ensure human safety during electrofishing operations by establishing Department of Environmental Quality competency requirements for electrofishing operations. This plan also provides guidelines for a standard operating procedure and the safe operation of electrofishing equipment.

2. **Scope**
   The provisions of this plan apply to all IDEQ activities using electricity (produced by gasoline powered generator/alternators or batteries) to sample animals in aquatic habitats.

3. **Policy**
   IDEQ recognizes the electrofishing operation as a hazardous activity for which skills and training is required. It is, therefore, IDEQ policy that all personnel serving as BURP (Beneficial Use Reconnaissance Program) coordinators demonstrate knowledge of the principles and techniques of electrofishing. BURP coordinators will be considered knowledgeable of the principles and techniques of electrofishing upon satisfactory completion of the US Fish and Wildlife Service, Principles and Techniques of Electrofishing course or equivalent training.

4. **Responsibilities**
   A. The IDEQ Health and Safety Coordinator is responsible for maintaining a current listing of all IDEQ personnel who have attended electrofishing training.

   B. The IDEQ Regional Administrators are responsible for ensuring compliance with the provisions of this plan.

   C. BURP Coordinators are responsible for:
      1) Providing electrofishing crews with the proper equipment, and ensuring that such equipment is fully functional at the beginning of the field season.
      2) Ensuring that the electrofishing crews have and utilize the proper safety equipment.
      3) Ensuring that all crew members are first aid and CPR certified.
      4) Ensuring the availability of a well-equipped, water-tight first aid kit.
      5) Discussing potential hazardous conditions encountered during electrofishing operations with crew members
      6) Ensuring that all crew members are trained in proper electrofishing techniques.
      7) Designating an electrofishing team leader.

   D. Electrofishing Team Leader. Only individuals demonstrating knowledge of electrofishing techniques can serve as electrofishing team leaders. As the individuals in charge of electrofishing operations, the team leaders are responsible for the following:
      1) Identifying hazardous field conditions associated with proposed electrofishing operations, determining measures to protect electrofishing team members, and appropriately briefing team members.

2) Ensuring precautions are taken in the field to avoid harm to the public, domestic animals, or wildlife
3) Ensuring that all electrofishing operations cease, and all crew members go ashore in the event of inclement weather.
4) Ensuring that electrofishing operations include only those persons necessary to conduct a safe and efficient operation and those members being trained.
5) Reviewing the electrofishing considerations checklist and ensuring the addition of specialized items to the checklist that pertain to their Regions or operation.
6) Inspecting electrofishing equipment during the field season to assure that it is properly functioning. If repairs are needed, this must be brought to the attention of the Regional BURP coordinator.

E. All crew members must know who their leader is and recognize his/her authority as final in operational decisions. Every crew member has the right to ask questions about any aspect of an electrofishing operation. A crew member has the right to decline participation in the operation if he/she feels unsafe working in the field conditions present. Crew members are responsible for reporting all potential work hazards, accidents, incidents, and job-related illnesses/injuries to their regional BURP coordinator.

5. Training and Education
   A. It is recommended that BURP Coordinators attend the US Fish and Wildlife Service, Principles and Techniques of Electrofishing course so that they have knowledge of the following:

      1) The basic principles of electricity and transmission of current in water.
      2) The basic concept and design guidelines for electrofishing equipment.
      3) Electrofishing equipment, the equipment's capabilities, limitations, and safety features.
      4) The safety precautions to employ, while using electrofishing equipment.

   B. All members of the electrofishing crew must have a current certification in cardiopulmonary resuscitation (CPR) and first aid. All crew members will be briefed in the following areas:

      1) Hazards involved in electrofishing.
      2) Safe operation of electrofishing equipment.
      3) Basic emergency procedures for drowning, unconsciousness, and electrical shock.
      4) Communication between electrofishing crew members while operating equipment.
6. Standard Safety Equipment
   A. All persons using portable electrofishers will wear protective gear which will insulate the wearer from electrical shock, preferably chest waders, but rubber hip boots would suffice. All footwear will be equipped with non-slip soles.

   B. Appropriate gloves will be worn and will be inspected for punctures before each use. They will be replaced if damaged.

   C. Polarized sunglasses will be worn when there is glare on the water.

7. Standard Operating Procedure
   All persons must be aware of the hazards involved in using portable electrofishers in running waters, such as slippery surfaces, swift water currents, deep areas; and obstacles, such as logs or similar objects.

   A. A minimum of three people should be present to conduct electrofishing operations.

   B. At all times during the electrofishing operation, the crew must communicate as to whether or not the unit is putting power into the water. If a crew member must reach into the water with their hands, it is their responsibility to inform the person operating the equipment, so they can stop the operation. Communication between crew members is essential to a safe operation.

   C. Netters will work beside or behind the individual with the electrofishing equipment to ensure the electrical field is well in front of both workers.

   D. Crew members should only perform one job at a time. A person should not be carrying the bucket of fish and netting at the same time.

   E. While walking in the stream, make sure that one foot is securely planted before stepping with the other foot. Do not cross one leg over the other, especially while walking in swift water.

   F. The individual operating the electrofishing unit should not turn the power on until all crew members are in position and have stable footing.

   G. Crew members will cease electrofishing operations during inclement weather; use discretion during rain.

   H. All safety equipment will be utilized.

   I. All operating manuals for electrofishing equipment must be available to the crew while in the field.

8. Portable Electrofisher Equipment Specifications and Operation
   Only professionally-produced electrofishing equipment should be used, and the equipment should not be altered in any way.

   A. Electrodes

      1) Electrode handles will be constructed of a nonconductive material, and be long enough to avoid hand contact with the water.

      2) The positive electrode (anode) used with portable electrofishers will be equipped with a pressure switch that interrupts the electric current upon release.

B. Portable Electrical Power Source

1) Batteries used as an electrical power source for backpack shockers will be of the gel type that will not leak when tipped or overturned.

2) Backpacks will be equipped with a quick-release belt (hip) and shoulder straps.

C. Power Control

1) The operator will have a switch to the pulsator or power control unit in order for the electricity to be turned off quickly in an emergency.

2) All equipment purchased after October 1, 1985 must be equipped with a tilt switch that breaks the circuit if the operator falls.

Idaho Beneficial Use Reconnaissance Program

Acknowledgement of Electrofishing Training

I have received instruction and orientation about electrofishing from the Idaho Department of Environmental Quality. As a result, I understand and accept the following principles:

1. Electrofishing (EF) is an inherently hazardous activity in which safety is the primary concern. The electrical energy used in EF is sufficient to cause electrocution. During operations, it is critical to avoid contact with the electrodes and surrounding water. The EF field is most intense near the electrodes, but can extend outward 10-20 feet.
2. A communication system must be known by all members of an EF crew. A minimum of three people are recommended for all EF operations. Crew members should only perform one job at a time (e.g. a person should not be carrying the bucket of fish and netting at the same time).
3. The individual operating the electrofishing unit should not turn the power on until all crew members are in position, have stable footing, and all members agree to begin.
4. An EF operation should proceed slowly and carefully; avoid fish-chasing and other sudden maneuvers. Operations should cease during inclement weather; use discretion during rain.
5. The main power switch must be turned off immediately, if an emergency occurs.
6. Rubber knee boots are minimal foot protection, as are rubber gloves for the hands. Chest-waders with felt soles are recommended. Ear protection is recommended for those working near the generator. Crews will be provided with the necessary safety equipment that is in proper working condition.
7. All members of the EF crew must be certified for CPR and first aid. A first aid kit must be accessible during an EF operation.
8. Stunned fish should be removed from the EF field as soon as possible, and not subjected to continuous power by being held in the field. Using the anode as a dip net should be avoided; it is a poor electrofishing technique, and potentially injurious to fish.
9. Measures should be taken to avoid harm to the public, domestic animals, and wildlife. The public cannot participate in electrofishing operations.
10. All EF crew members must know who their leader is and recognize his/her authority as final in operational decisions. However, every crew member has the right to ask questions about any aspect of an EF operation. A crew member has the right to decline participation in an EF operation, without fear of employer recrimination, if he/she feels unsafe in doing such work.

_____ / _____ .

Signature of Employee Date

Appendix I

DEQ Fish Taxon Codes

FTAXACODE	AFSCNAME	AFSSNAME
1	Pacific lamprey	*Lampetra tridentata*
2	white sturgeon	*Acipenser transmontanus*
3	American shad	*Alosa sapidissima*
4	lake whitefish	*Coregonus clupeaformis*
5	chum salmon	*Oncorhynchus keta*
6	coho salmon	*Oncorhynchus kisutch*
7	sockeye salmon	*Oncorhynchus nerka*
8	kokanee	*Oncorhynchus nerka*
9	chinook salmon	*Oncorhynchus tshawytscha*
10	rainbow trout	*Oncorhynchus mykiss*
11	cutthroat trout	*Oncorhynchus clarki*
12	Bear Lake whitefish	*Prosopium abyssicola*
13	pygmy whitefish	*Prosopium coulteri*
14	Bonneville cisco	*Prosopium gemmiferum*
15	Bonneville whitefish	*Prosopium spilonotus*
16	mountain whitefish	*Prosopium williamsoni*
17	golden trout	*Oncorhynchus aguabonita*
18	Atlantic salmon	*Salmo salar*
19	brown trout	*Salmo trutta*
20	Arctic char	*Salvelinus alpinus*
21	brook trout	*Salvelinus fontinalis*
22	bull trout	*Salvelinus confluentus*
23	lake trout	*Salvelinus namaycush*
24	Arctic grayling	*Thymallus arcticus*
25	rainbow smelt	*Osmerus mordax*
26	northern pike	*Esox lucius*
27	chiselmouth	*Acrocheilus alutaceus*
28	goldfish	*Carassius auratus*
29	lake chub	*Couesius plumbeus*
30	common carp	*Cyprinus carpio*

31	Utah chub	*Gila atraria*
32	tui chub	*Gila bicolor*
33	leatherside chub	*Gila copei*
34	peamouth	*Mylocheilus caurinus*
35	fathead minnow	*Pimephales promelas*
36	northern pikeminnow	*Ptychocheilus oregonensis*
37	longnose dace	*Rhinichthys cataractae*
38	leopard dace	*Rhinichthys falcatus*
39	speckled dace	*Rhinichthys osculus*
40	redside shiner	*Richardsonius balteatus*
41	tench	*Tinca tinca*
42	Utah sucker	*Catostomus ardens*
43	longnose sucker	*Catostomus catostomus*
44	bridgelip sucker	*Catostomus columbianus*
45	bluehead sucker	*Catostomus discobolus*
46	largescale sucker	*Catostomus macrocheilus*
47	mountain sucker	*Catostomus platyrhychus*
48	black bullhead	*Ameiurus melas*
49	brown bullhead	*Ameiurus nebulosus*
50	channel catfish	*Ictalurus punctatus*
51	tadpole madtom	*Noturus gyrinus*
52	flathead catfish	*Pylodictis olivaris*
53	sand roller	*Percopsis transmontana*
54	burbot	*Lota lota*
55	western mosquitofish	*Gambusia affinis*
56	guppy	*Poecilia reticulata*
57	green sunfish	*Lepomis cyanellus*
58	pumpkinseed	*Lepomis gibbosus*
59	warmouth	*Lepomis gulosus*
60	bluegill	*Lepomis macrochirus*
61	smallmouth bass	*Micropterus dolomieu*

62	largemouth bass	*Micropterus salmoides*
63	white crappie	*Pomoxis annularis*
64	black crappie	*Pomoxis nigromaculatus*
65	yellow perch	*Perca flavescens*
66	walleye	*Stizostedion vitreum*
67	mottled sculpin	*Cottus bairdi*
68	Paiute sculpin	*Cottus beldingi*
69	slimy sculpin	*Cottus cognatus*
70	shorthead sculpin	*Cottus confusus*
71	Bear lake sculpin	*Cottus extensus*
72	Shoshone sculpin	*Cottus greenei*
73	Wood river sculpin	*Cottus leiopomus*
74	torrent sculpin	*Cottus rhotheus*
75	lamprey	*Lampetra sp.*
76	sturgeon	*Acipenseridae sp.*
77	whitefish	*Coregonus sp.*
78	Pacific salmon/trout	*Oncorhynchus sp.*
79	whitefish	*Prosopium sp.*
80	Atlantic salmon/trout	*Salmo sp.*
81	char	*Salvelinus sp.*
82	grayling	*Thymallus sp.*
83	pike	*Esox sp.*
84	chub (Couesius sp.)	*Couesius sp.*
85	chub (Gila sp.)	*Gila sp.*
86	pikeminnow	*Ptychocheilus sp.*
87	dace	*Rhinichthys sp.*
88	shiner	*Richardsonius sp.*
89	sucker	*Catostomus sp.*
90	catfish	*Ictalurus sp.*
91	trout-perch	*Percopsis sp.*
92	sunfish	*Lepomis sp.*

93	bass	*Micropterus sp.*
94	crappie	*Pomoxis sp.*
95	perch	*Perca sp.*
96	sculpin	*Cottus sp.*
97	herring	*Clupeidae*
98	trout	*Salmonidae*
99	minnow	*Cyprinidae*
100	catfish	*Ictaluridae*
101	guppy	*Poeciliidae*
102	sunfish	*Centrarchidae*
103	perch	*Percidae*
104	bullhead	*Ameiurus sp.*
105	cod	*Lota sp.*
106	smelt	*Osmerus sp.*
107	oriental weatherfish	*Misgurnus anguillicaudatus*
108	weatherfish	*Misgurnus sp.*
109	loach (cobitidae)	*Cobitidae*
110	convict cichlid	*Cichlasoma nigrofasciatum*
111	blue tilapia	*Tilapia aurea*
112	Mozambique tilapia	*Tilapia mossambica*
113	redbelly tilapia	*Tilapia zillia*
114	shortfin molly	*Poecilia mexicana*
115	green swordtail	*Xiphophorus helleri*
116	yellow bullhead	*Ameiurus natalis*
117	steelhead	*Oncorhynchus mykiss*
118	grass carp	*Ctenopharyngodon idella*
119	spottail shiner	*Notropis hudsonius*
120	blue catfish	*Ictalurus furcatus*
121	platy	*Xiphophorus sp.*
122	sauger	*Stizostedion canadense*
123	Umpqua dace	*Rhinichthys evermanni*

124	umatilla dace	*Rhinichthys umatilla*
125	tilapia	*cichlidae*
156	killifish	*Cyprinodontidae*
157	banded killifish	*Fundulus diaphanus*
501	cutthroat trout (all stocks) x rainbow trout	*Oncorhynchus clarki X O. mykiss*
502	brook trout x bull trout	*Salvelinus fontinalis X S. confluentus*
503	brook trout x lake trout (splake)	*Salvelinus fontinalis X S. namaycush*
504	brook trout x brown trout (tiger trout)	*Salvelinus fontinalis X Salmo trutta*
505	tiger muskellunge	*Esox lucius E. masquinongy*
9999	fish	*Unidentified*

Appendix J

Electrofishing Checklist

Electrofishing Checklist

Backpack Electrofisher Daily Safety Inspection

Date:_____ Stream: _____

Electrofishing Leader: _____ Crew ID:_____

Crew Members:_____

Manual present? Yes _____ No _____

GENERATOR/ALTERNATOR (if applicable)

_____ 1. Electrical connections secure and protected

_____ 2. Mountings secure

_____ 3. Exhaust directed away from operator

_____ 4. Oil topped up

_____ 5. Gas topped up

_____ 6. Engine clean - no oil or gas leaks

ELECTROFISHER

_____ 1. Controls and gauges operational

_____ 2. Adequate protection of wiring

_____ 3. Adequate connectors and interlocking

_____ 4. Audible tone generator working

_____ 5. "Kill switch" working

_____ 6. Mercury tilt switch working

_____ 7. Anode switch working

_____ 8. Wiring to anode in good condition

_____ 9. Anode in good condition, fastened securely

_____ 10. No screens or nets attached to anode

_____ 11. Cathode in good condition

_____ 12. Cathode clean, fastened securely

_____ 13. Backpack frame in good condition

_____ 14. Quick release buckle of backpack working

PERSONNEL/CREW MEMBERS

_____ 1. Each crew member briefed on unit operation

_____ 2. It is recommended three or more crew members be present, all CPR certified

_____ 3. Each crew member wearing rubber gloves

_____ 4. Each crew member wearing waders or rubber boots

_____ 5. Safety precautions covered

_____ 6. Local arrangements covered (landowner, Fish & Game)

BATTERY (if applicable)

_____ 1. Fully charged, gel type cell

_____ 2. Terminals clean and tight

ANCILLARY EQUIPMENT

_____ 1. Non-conductive dip net handle

_____ 2. First aid kit present

_____ 3. Regulation gas containers

_____ 4. Fish holding containers

_____ 5. Fish measuring board

_____ 6. Jars with formalin

_____ 7. Fish labels

_____ 8. Fish field forms

_____ 9. Formalin safety equipment